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ABSTRACT

Designed to provide instructors with resource materials for driver education, this book contains mainly materials on established safe driving procedures. An introduction defines a procedure as describing ways in which a driver can comply with the law to do something extra that will increase his/her safety and prevent congestion and collision. Examples and descriptions of procedures and laws are provided, and suggestions are made for incorporating discussion of procedures into driver education. These categories of driving procedures are discussed: city driving; rural driving; night driving; winter driving; driving on mountain roads; driving on freeways; driving in fog; driving in sandstorms; driving on slick roads and running off roadway; driving in mud, water, and rain squalls; problems and procedures involving trucks; railroad crossing procedures; driver signals; traffic signs, markings, and signals; applying brakes on automobiles; blowout hazards and recovery procedures; passing problems on two-lane city streets; transitions between roadways; small barricades in one lane of a multilane roadway; use of rearview mirror in approaching an intersection; checking left lane before starting to overtake and pass; the right-of-way and how to show drivers you will yield it; yielding right-of-way to emergency vehicles; braking distance charts; vehicle acceleration and deceleration; and following distances. Two final sections address littering and the square principle. (YLB)

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A RESOURCE GUIDE

FOR

DRIVER EDUCATION TEACHERS

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James B. Adams, Director

Texas Department of Public Safety

1984

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FOREWORD

This book has been prepared by the Texas Department of Public Safety as an effort to provide resource material for driver education. It mainly contains material on established safe driving procedures.

Sound driving procedures, although closely allied with traffic laws, are based on experience and civil law doctrines as well as statutory laws. Instructors should insure that students do not confuse acts required by law with acts recommended as defensive procedures.

We sincerely hope that the "Driving Procedures" book will be helpful to driver education instructors in the performance of their duties.

James B. Adams

James B. Adams, Director
Texas Department of Public Safety

INTRODUCTION

A driving procedure is a manner of operating a motor vehicle. A procedure may be safe or dangerous. A sound procedure is based on (1) the traffic law, (2) civil law doctrines, and (3) experience and may involve one or more of these three elements. Lessons in driving procedures contain discussions of good and bad features of various driving habits and maneuvers, with recommendations that will help a driver avoid collisions and prevent congestion.

A traffic law may simply describe what a driver must do or must not do. Procedure describes ways in which a driver can comply with the law or do something extra that will increase his safety and prevent congestion. For example, the law says that a driver shall park a vehicle out of a roadway. A driver complies with this law on a paved rural highway when his car barely clears the pavement. Experience teaches that it is poor driving judgment just to meet the letter of this law, if there is room on the shoulder for a driver to park his car far enough from the pavement that the driver's door when opened will clear the pavement. Procedure, in this instance, prescribes more than the minimum precautions required by law, when it is possible to park four feet from the pavement or when it is reasonable to drive to a place where one can park more safely than the law requires.

Civil law doctrines involved in determining negligence include (1) Keeping a Proper Lookout and (2) Reasonable and Prudent Action. Procedures are based in part upon these doctrines.

If you are struck by a car entering an open intersection from your left, the driver of the car on the left might be found guilty of failing to yield the right-of-way. Suppose you enter a civil suit against the driver to recover damages and it develops in testimony that when you entered the intersection you were turned in your seat looking at a passenger in the back seat of your car. You might very well be accused of negligence yourself; that is, your failure to do what a reasonable and prudent person operating a motor vehicle would do might constitute negligence, without which the collision may not have occurred. It may turn out that the other driver's brakes had just failed and that he was unable to yield right-of-way. You then would have had an opportunity to prevent the collision. You might be denied payment or receive a smaller payment for damages because you failed to keep a proper lookout.

Traffic law says that a driver shall drive on the right half of a public road. This law protects a driver who is on the right side from a driver who might cross the centerline. However, civil law doctrine demands that the driver on the right side do more than merely stay on the right side.

If you encounter a traffic law violator on the wrong side in time to escape to the shoulder and prevent a collision and you do not go to the shoulder, you may be guilty of negligence. The violator may be experiencing an emergency of some sort, such as a defective steering gear, and he may be doing all that he can to get back onto the right side. You may be the driver who has the last opportunity to take action to prevent a collision. This illustration points up an important principle of defensive driving. A defensive driver takes the same precautions whether or not another driver is committing a law violation deliberately or due to some force which the violator cannot control.

Traffic laws are guides to aid drivers in preventing collisions, but compliance with traffic laws does not relieve a person of the basic humane responsibility of acting in a reasonable and prudent manner to avoid doing injury or damage to another person. This responsibility of a citizen existed long before automobiles were invented, but more citizens have learned about it as a result of the automobile than from any other source.

Civil law doctrine is extremely complex and involves many facets of civil law too numerous to mention here. These elementary illustrations are intended to point up the relationship between defensive driving and citizen responsibility. A large majority of all traffic accidents involve violations of traffic laws. This experience attests the fact that the laws are good guides to safe driving. Many violators do not know they are violating laws. The cure for this lack is thorough training in traffic laws. Many drivers know the laws but do not know how to operate motor vehicles so that they will not be forced into violations unintentionally. The cure for this lack is thorough training in driving procedures. Since driving procedures are based partly on law and do not contradict law, a thorough knowledge of procedures will aid both groups of drivers.

A traffic law violator involved in an accident has both the violation and the accident charged to his driving record. A bad driving record can result in a suspension of his privilege to drive on public roads regardless of the size of the fines assessed for his violations. The state's authority to withdraw the privilege to drive on public roads, not the fine, is, in the last analysis, the key factor of driver control.

A reasonable and prudent person will drive legally, will keep a proper lookout and will act to reduce the danger of a hazard the instant he encounters a dangerous situation. If a driver involved in an accident did these things preceding the accident he will have acted to protect himself against damage claims and his license against suspension.

It should be pointed out, however, that a driver may act to reduce danger the instant he discovers that a collision is imminent and still may be negligent. For example, a driver approaching a blind intersection too fast, might do all he can to stop or dodge a car on the cross street after he discovers the car is there, yet be negligent because he approached at a speed faster than a reasonable and prudent person would have driven. In other words a driver may be negligent in failing to reduce his speed to a reasonable rate when he knows that on arrival at some point ahead, such as a blind intersection, he is very likely to discover that he may collide with another vehicle.

Too often a nondefensive driver fails to realize that his responsibility in preventing collisions does not always start at the point of discovered peril, but rather may start several seconds before he arrives at a point where he can actually see that a collision is imminent. A driver may keep a proper lookout and do all that any person can do to prevent a collision once he sees a collision is imminent, but still have failed to do what a reasonable and prudent person would have done a few seconds before he arrived at the point where he could see that a collision was imminent.

For example, a driver who is following too close on wet pavement locks his brakes to prevent colliding with the vehicle ahead, which decelerated quickly, and skids into opposing traffic. He says, "I did all I could—what else could anybody do except try to stop quickly?" The answer does not lie exclusively in whether or not he did all he could after the car ahead decelerated quickly, but partly in whether or not his action of following a vehicle at the distance he was following was reasonable and prudent for the vehicle speeds involved and the wet pavement.

Another example of driver failure to understand responsibility is the driver who passes a stop sign, is involved in a collision and tries to excuse himself by saying that he did not see the stop sign. He virtually acknowledges that he failed to keep a proper lookout, yet he uses this instance of negligence in defense of his failure to comply with the law. Let us suppose that there was no stop sign and that he collided with a vehicle approaching on his right. How would the driver defend his action? Even though he does not see the stop sign he still is faced with the potential need of yielding at the intersection.

A driver who learns and complies with traffic laws can never prevent as many accidents as a driver who learns and complies with both traffic laws and defensive driving procedures. The latter helps protect him from violators of traffic laws. The student also should understand ways in which defensive driving can protect him against charges of negligence. Providing this understanding is a serious responsibility of driver education instructors. An instructor should ground himself in both traffic laws and driving procedures. He should analyze for his students the factors contributing to accidents as these factors relate to traffic laws and as they relate to negligence. If he does less he denies his students an understanding of their citizen responsibility.

Road rules are the traffic laws that relate to **positions** of vehicles on a roadway. These **position** laws aim at regulating the movements of vehicles so that conflicts will not occur. Early in the history of the automobile, experience showed that the first law of the road, driving on the right side of a road, while satisfactory for horse drawn vehicles, was not enough for motor propelled vehicles.

It was important that all drivers have an understanding of reasonable rules of conduct, so to speak, so that each driver not only would know how to position his vehicle when conflicts were imminent but also could assume that the other drivers knew how to comply with the common rules. As speeds of vehicles increased it was recognized that even though drivers knew how to position their vehicles under varying traffic conditions, they still would not be able to comply with the rules unless they could assume in advance that a vehicle was going to alter its position in the roadway. The need of some sort of code of communication among drivers was apparent. As a result a uniform signal code for turning and slowing has evolved. Hand and arm, electric turn and stop light signals, and how and when these signals shall be used are parts of this signal code. The signal laws are not **position** laws. They are laws that help drivers help each other comply with **position** laws.

Position laws include such rules as right-of-way at intersections and railroad crossings, changing directions in the roadway as in turns and in moving from one lane to another, entering traffic from a parked position, overtaking and passing, and parking off a roadway. There are many others.

Some traffic laws aim **directly** at helping drivers prevent **position** law violations. Among these are laws regulating brakes, headlights, tail lights, clearance lights, signals, speeds, and drivers drinking intoxicating liquors or taking drugs.

A third group of traffic laws aim **indirectly** at preventing **position** violations. This group includes licensing laws and driver improvement laws based on the driver records which licensing makes possible. In this group is the vehicle inspection law, as well as laws regulating traffic engineering controls and driver education.

In the final analysis, most traffic laws aim at preventing position conflicts which cause collisions and congestion. These laws are based on experience. Many traffic situations present problems for drivers who know the laws but do not know how to maneuver a vehicle in order

to comply with the laws effectively. Filling this gap is one of the purposes of driving procedures. It may take only five minutes to teach all of the laws regulating overtaking and passing. It may take twenty minutes to discuss all of the hazards involved in trying to comply with these laws and to explain defensive procedures relating to maneuvers which these laws regulate. The procedures, like the laws, are based on experience, but the procedures also include information on how and when to act to avoid conflicts with other drivers and pedestrians who commit position violations. Procedures encompass guides in maintaining eye and mind attention, in recognizing potential traffic hazards, and in developing self-discipline to act early to avoid conflicts.

The job of teaching a student to drive intelligently is essentially a job of teaching him driving procedures. The job can be done more effectively if the student first understands traffic laws and the responsibility the laws place upon him; physical laws and the limitation these laws place upon his control of a car; traffic engineering signs, signals, and markings and why they are essential; and mechanical controls on a car and how to coordinate them to control the car. In teaching driving procedures an instructor draws heavily upon this knowledge in developing a student's judgement and discipline. An instructor can teach all of the above subjects, but unless he ties their contents together in teaching procedures he may graduate students who make A's in those subjects yet still lack judgment and discipline to operate a car safely in modern traffic.

Attention is directed to the flexibility of recommendations in some of the procedures which is necessary to meet needs of a wide variety of vehicles and drivers.

One example is the references to use of gears which will not apply if a vehicle has an automatic transmission. For instance, it is recommended that a driver shift to second gear before entering traffic from a shoulder. The purpose of this procedure is to get the car into the gear which will provide faster acceleration more quickly and for some distance in traffic, to get the shifting done early so that the driver can have two hands free to steer when he enters traffic, to let the driver get in a better position to check traffic to the left rear through having his right hand on the wheel, and to eliminate a distraction which might prevent a driver from giving full attention to checking traffic to the left rear. An automatic transmission provides all of these advantages. But since there will always be some gearshift vehicles, it is necessary to treat gearshift problems in discussing procedures. To a person who thinks the gearshift is obsolete the instructor might point out that the opinion is an example of a difficult obstacle in driver education.

Another example is the references to use of hand and arm signals. While the electric directional turn signal has almost totally replaced the hand and arm signal, there will always be vehicles not equipped with turn signals or equipped with defective turn signals. Aside from the fact that there are times when only a hand and arm signal will suffice or when both types of signals should be used, it is essential that all drivers know exactly how to give hand and arm signals correctly should their electric signals go defective, and be able to recognize the signals when given by drivers of other vehicles.

These two examples should alert the instructor against omitting discussions of those aspects of some procedures which he might think are obsolete.

An instructor must know traffic laws thoroughly in order to avoid misinforming students on points of law. For example, it is recommended that a driver before entering traffic from a right shoulder or parallel parking stall (1) give a left turn signal, (2) look back down the traffic lane, and (3) if traffic is near to wait until he can enter safely. The law regulating this maneuver says simply that the driver shall not start "until such movement can be made with safety." Full responsibility is on the starting driver and he should not be led to think that giving a signal lessens his responsibility in any degree. The "looking back" and "giving a signal" are only procedures, intended to help a driver comply with the law. Although a driver is turning as he enters traffic, the only turn signal that is mentioned in the law must be given for a distance of at least 100 feet, and a driver entering traffic from a parallel parking stall usually could not give the signal for this distance. Although it is difficult to imagine how a driver could "enter safely" without looking back, still the law does not specify how he shall determine when it is safe to enter. In the recommendations for this maneuver we have, therefore, two which are purely procedures and one which is law, even though one procedure (the turn signal) is a law in some other maneuvers.

Driver education should interpret ideas and develop concepts from several fields: psychology, physiology, sociology, government, law, physics, enginering, economics, management, etc. Driver education should seek to translate these concepts into a distinctly new discipline called Defensive Driving Procedures. It should start the development of habit patterns which will help the student practice self-discipline throughout his driving experience.

As a part of a comprehensive traffic control program driver education seeks to promote economic and social welfare by increasing efficiency of our transportation system through reductions in congestion, property damage, injuries, and deaths.

A valuable course project which will motivate students to think about defensive driving procedures is a notebook containing

1. Newspaper articles describing traffic accidents with the student's analysis of the probable causes and what the driver(s) could have done to prevent the collision or overturn.

2. Student sketches showing traffic hazards developing, with student's analysis of what the driver(s) should do, and when, in order to prevent the impending collision or overturn.

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CITY DRIVING

1. General Precautions

a. Driving in city traffic requires more constant attention to more details to prevent collisions than driving on most rural highways because:

(1) Vehicles moving closer together and alongside many parked vehicles require quicker decisions.

(2) Intersections are more frequent.

(3) Directional signs and signal lights are more frequent.

(4) There are more obstructions to vision.

(5) Pedestrians are more numerous and, like the drivers, are more easily confused.

(6) There are more sources of mental distraction, one of which is flashing colored lights in advertising signs.

b. Rely on the speedometer and not on your feelings to reduce your speed to a legal rate when you enter a city from a rural highway. A change of speed from 55 mph to 40 mph may make you feel as if you are going 20 mph, when actually you may be traveling at a hazardous speed for traffic conditions present.

c. Self-discipline is required when moving from a business area to a residential area. When you get free of congested traffic, you are likely to relax caution and exceed a safe speed. In residential areas the damages in traffic accidents are more severe than in business areas. Speed is one factor that increases the severity of an accident.

d. The danger of speed is deceptive. A person's common sense tells him that 40 mph is twice as dangerous as 20 mph. Does not four gallons of water weigh twice as much as two gallons? Is not 40 mph twice as fast as 20 mph? Then surely 40 mph is just twice as dangerous as 20 mph! This is commonsense reasoning. But it is wrong, and it has caused the deaths of tens of thousands of drivers and passengers. The energy of a moving object increases in proportion to the increase of the square of the speed. This is a natural law, like gravity. A person can feel gravity when he carries water, but a driver in a modern car cannot feel the energy of motion until he hits something.

e. How much does the energy of a car going 40 mph increase over its energy at 20 mph?

$$\frac{40^2}{20^2} = \frac{1600}{400} = 4 \text{ times as much}$$

Common sense would tell you it is twice as much, but note that it takes approximately 28.28 mph to develope twice as much energy as at 20 mph:

$$\frac{28.28^2}{20^2} = \frac{800}{400} = 2 \text{ times as much}$$

Actually at 28.28 mph the energy is the amount a driver would expect at 40 mph.

f. These are facts about speed which drivers should learn early and respect. It takes only a slight push of the gas pedal to increase your speed from 20 mph to 28 mph but the destructive power of your car is doubled when you add this 8 mph to your speed. If you will think about the energy law seriously, you will understand the importance of speed limits, which are intended to serve as guides for drivers who do not understand the hazards created by the speeds of automobiles.

2. Entering Traffic from Driveway, Alley, or Parking Zone

a. When entering a street from a private driveway or alley:

(1) Drive out forward if practicable.

(2) Stop at the sidewalk and stop again before entering the traffic lane, if your view of traffic is obstructed.

(3) Check for pedestrians who may enter the path of your vehicle.

(4) Sound your horn before your bumper reaches the sidewalk area if your vision is obstructed such as when driving from a garage onto a sidewalk area.

(5) Cross the sidewalk area only when clear of pedestrians.

(6) Wait until you can enter the street without interfering with other vehicles.

(7) Turn to the right when moving forward into a street where left turns would interfere with traffic. This procedure is required by many cities on streets carrying heavy traffic. When your vehicle is clear of curb or parked vehicles, cut sharply to the right and drive forward into the near lane of a multilane street. If the street is two-lane use only the right half of the street as nearly as possible.

(8) Accelerate immediately to the normal safe driving speed and blend with the flow of traffic in the area.

b. When entering a street from a parallel parked position:

(1) Before entering your car look around it. Note position of car wheels with curb. Before backing your car look back and sound horn if a pedestrian is in the parking stall or is on the curb nearby.

(2) Back slowly to a point from which you can pull forward out of the parking stall.

(3) Look to the rear out of driver window and if several vehicles are approaching wait in neutral gear and do not signal until last vehicle is passing.

(4) As vehicle(s) pass shift to low or drive gear and look to the rear again. If the area is clear, give a left turn signal before pulling out into the traffic lane. After your car is in the lane far enough to be seen by drivers in traffic, keep both hands on the steering wheel.

(5) Pull out only if traffic is clear to the front. Look for vehicle parked ahead of you which may be leaving the curb; and on a two-lane street, look for an opposing vehicle which may be overtaking and passing on your side of the street.

(6) Keep to the right side of the street on the pull-out and accelerate immediately to the normal driving speed for the area.

c. When entering a street from an angle parking position:

(1) Before entering your car, check the angle of your front wheels, the clearance between your car and vehicles on either side and the angle your vehicle makes with other vehicles. This information will aid you in backing.

(2) Before moving your car check traffic by looking to the right rear; check rear for double parked car and jaywalkers and then check left to be sure a vehicle is not using your side of the street in a pass.

(3) Back out slowly as you check right rear for approaching traffic. If traffic is near yield by easing forward.

(4) Back to the right and as soon as your vehicle clears the line of parked vehicles, turn wheels to left; drive forward and accelerate immediately to the normal driving speed for the area.

(5) Avoid backing across the centerline of a two-lane street or into the near inside lane of a four-lane street.

(6) Always sound horn before backing if pedestrians are in the immediate area.

(7) Be sure taillights are on before backing at night.

(8) When there is a stop-and-go light at the intersection behind you, you will have less interference from traffic if you wait and back out when the light is red.

(9) When you are backing from a stall near an intersection to your rear, the hazard of a car turning right into your lane is increased. Keep a lookout for such a car and be ready to sound your horn or to drive back into the stall.

d. When entering a traffic lane from any private property:

(1) If you are leaving private property to enter a four-lane, two-way street and you wish to get into the inside lane, do not enter the outside lane and stop where you will obstruct traffic while waiting for an opening to get into the inside lane. This error usually occurs when a driver enters from a parking lot or a service station near an intersection where he wants to turn left. Either stay out of the street until you can move directly into the inside lane or line up with traffic in the outside lane.

(2) If you are leaving a parking area to enter the other side of a street (this is prohibited on streets with heavy traffic in some cities), do not move into the near side of the street and block traffic while waiting for an opening to get into traffic on the far side. Do not enter the street until you can get your entire car across the centerline in one movement. Sometimes traffic on the far side will be congested by a stop sign or a signal light when traffic is moving freely in the near side lane. You should not congest traffic in the near side lane by stopping your car half way across the centerline.

(3) If you have to stop to wait for a line of traffic to clear when you are entering a city street from a private driveway or from a public drive-in area, stop with the front of your car at least five feet from the line of traffic. This distance will place you close enough to the traffic lane to see down the roadway and far enough from the lane to avoid slowing down traffic. Stopping close to the line of traffic will only increase your delay, because the closer you are to the traffic, the greater the number of drivers who will slow down as a defensive procedure.

3. Cruising in City Traffic

a. Speed Control:

(1) Adjust your speed to blend with the flow of traffic when traffic is heavy, provided the traffic is not exceeding the speed limit.

(2) Alter your speed to avoid hazards you detect whether

or not other drivers do. The other drivers may not see the hazards. Do not follow them into traps.

(3) Be the first driver to reduce speed when it rains, but check your mirror first and signal if a vehicle is close behind you.

(4) Avoid delaying traffic by an unnecessarily slow speed; if you cannot or do not want to drive with the traffic, give way to the right to let cars pass or move to another street where you will not cause congestion.

b. Keep your vehicle in one lane and as nearly in the center of the lane as practicable to provide maneuvering room in emergencies.

c. Change lanes only when necessary and then only after giving a turn signal and after checking the mirror for overtaking vehicles. Looking to the side is the only way to be certain that the adjoining lane is clear. Even an outside mirror can leave a blind spot.

d. Always signal at least 100 feet before changing lanes. When you are approaching an intersection on a four-lane street and you need to change lanes in order to move straight ahead around a turning vehicle, you should stop your signal immediately after you enter the adjoining lane so that drivers will not think you plan to turn into the cross street.

e. On a roadway that does not have a centerline, you are as much responsible for keeping to the right of the center as you are for keeping to the right of a centerline. If you drive in the middle of a narrow street, even though it has no centerline, you are driving on the wrong side.

f. On a wide two-lane roadway that does not have lane lines, you should maintain a position within your side of the street that will permit a line of traffic to pass either to the right or to the left of you. That is, do not drive in the center of the right half of a street that is wide enough for two cars to move side by side. When you move right or left you should look to the side to clear traffic just as you do when changing traffic lanes separated by a broken line.

g. Slow down or stop when your lane is obstructed by a vehicle or pedestrian to permit opposing traffic (on two-lane street) or traffic from rear (on a multiple-lane street) to clear before you change lanes. You may give way to a pedestrian or vehicle that is near or in your traffic lane, but do not cross the lane line if you will interfere with vehicles in the other lane. If crossing the lane line will create interference, you should yield to traffic in the other lane.

h. When you are on a four-lane roadway and your lane is open and the adjoining lane is obstructed by a pedestrian or a vehicle, make certain a driver in the obstructed lane will stay in his lane before you pass the hazard. If it appears that the other driver is inattentive and driving too fast to slow down safely for the hazard in his lane, you should signal traffic behind you immediately with hand signal and/or by flashing your stop light and prepare to leave your lane open for the inattentive driver who may be forced into your lane.

i. When a driver just ahead and to the right of you in the outside lane of a four-lane road is approaching a hazard, such as a pedestrian, which is close to his lane, you should give way to the left in your (inside) lane so that the two vehicles will not be close together near the lane line. Do not, however, drive on the center stripe or endanger opposing traffic.

j. When you are on a two-lane roadway meeting another vehicle and this vehicle's lane is obstructed by a vehicle or a pedestrian, make certain the other driver will stay in his lane before you pass the hazard.

k. If the lane of an opposing driver (on a two-lane road) is not obstructed yet a vehicle or a pedestrian is near his lane and it is apparent that the driver will give way to the left within his own lane, you should give way to the right of your lane so the two vehicles will not meet near the centerline.

There is a situation related to the one described in the preceding paragraph. Some cities have hilly streets. If you are approaching a hilltop on a narrow, two-lane, two-way street, look ahead for the tops of cars that may be parked at either curb just beyond the crest of the hill. Consider meeting another car, possibly a wide truck, abreast of these parked cars and reduce your speed enough that you can stop if such a trap develops. If a parked car is on your side of the street, you may have to drive in the center of the street to pass it safely. If the other curb is vacant, a meeting driver may not recognize the hazard created by a parked car across the street from him, and he may approach the hilltop too fast to stop should you drive in the center of the street. Your problem here is just like one on a level street except you have to use a little imagination to visualize the trap beyond a hilltop. If a parked car is on your side of a hilltop and at the curb across the street, you should expect a car coming over the hilltop to use the center of the street to clear the parked car. As a defensive driver you will have to plan ahead to compensate for the other driver's error, as well as to avoid obstructing the other driver's lane, depending on where the parked car is.

l. When one lane of a two-lane, two-way road is closed to traffic for construction or repair, you must share the open lane with opposing traffic regardless of which direction you are going. The open lane becomes a two-way roadway and drivers from both directions must slow down and share the open lane. You should yield the right-of-way to vehicles traveling in the usual direction in the unobstructed lane.

m. On a three-lane, two-way street, use the center lane only

for overtaking and passing or for approaching and starting a left turn.

n. Do not enter the center lane to overtake and pass if an intersection is ahead and there are opposing vehicles, one of which may want to use the middle lane for a left turn. When another driver approaching an intersection in the middle lane for a left turn sees you in the center lane approaching the intersection from the opposite direction he expects you to turn left. Both of you should be giving left turn signals.

o. On multilane (two or more lanes in each direction) two-way streets, drive in any lane on the right-hand side. Overtake and pass either to the right or left, but never cross the centerline, unless directed by an officer or the right side is barricaded for road repairs. It is the responsibility of the overtaking driver to see that a pass will not create a hazard, even though his lane is open. A driver ahead is equally responsible for signaling and looking to the side before driving into the open lane.

p. On a one-way street you may maneuver from one lane to another so long as you do not create a hazard for a vehicle that is using a lane you are entering. You should signal and look to the side before changing lanes.

q. Traps on four-lane roads:

(1) You are in the outside lane and you see that a car in the inside lane is following a vehicle which appears to be preparing for a left turn. If the following car is going too fast or is too close to the vehicle ahead to make a normal safe stop, you should alter your speed, up or down, to avoid being at the spot where the following car might pull into your lane to miss the vehicle ahead. Or, if there is room, you might pull to the right side of your lane to provide a wider safety margin between your car and the two vehicles in the inside lane.

(2) The same kind of trap can develop when you are in the inside lane and a car in the outside lane is following a vehicle which you see is going to make a right turn. This situation may be more dangerous than the preceding one, because you will be exposed to opposing traffic on the left side of the street. It will be safer to slow down than to risk being shunted across the center line.

(3) When a vehicle ahead of you in either lane is stopped or is slowing down without warning, a car behind this vehicle must either slow down or change lanes to avoid a collision. If your car is the one following the slowing vehicle, you must avoid driving into the adjoining lane if a vehicle in it is overtaking you. If another car is following the slowing vehicle, you should expect this car to move suddenly into your lane.

(4) When you are in either lane and a driver ahead of you in the other lane reduces his speed, you should be prepared for him to cut across your lane in front of you to make a right or left turn. You may expect this problem especially on the approach to an intersection when the driver has delayed getting into the correct lane for a turn.

You may expect it also in midblock when the driver will be trying to turn off into a private driveway. If you do not expect such antics, you are an inexperienced driver.

(5) To avoid these traps you must keep a constant check on traffic fore, aft, and to the side of your vehicle. You can anticipate traps by observing distractions of drivers in other vehicles, positions or slight changes in directions of other vehicles, and speeds or changes in speeds of other vehicles. You must relate these factors to one another, sometimes for quite a distance ahead or to the rear, and alter your speed or position and give turn, slow, or horn signals to compensate. Heavy traffic on a four-lane street is so complex that a driver thereon either is preventing traps or is creating them.

r. When you see a vehicle stopped at a stop sign on a cross street ahead of you, be prepared to yield the right-of-way. Your speed and the distance your car is from the intersection are factors the other driver is considering to determine whether he can cross your lane without forcing you to make an unsafe stop. If the other driver makes a poor decision, a collision may result. When you are far enough away for the other driver to enter your lane, it is your responsibility to yield. Do not forget that. When you are too close for him to enter, the responsibility shifts to him. However, should he enter, your job is to help prevent a collision by reducing your speed and by giving a slow signal for the driver at the stop sign and for drivers behind you.

s. An accepted guide for a safe distance to follow another vehicle is to maintain at least two seconds following distance behind the vehicle ahead. You can determine the two-seconds following distance by counting to yourself, "1,001, 1,002" as the vehicle ahead passes a given point on a highway. If you reach that point before you finish counting, you need to allow additional following distance. If you depend on this rule, you must first learn to recognize distances by observing measured distances between objects and, second, you must keep your eyes on traffic. Develop an awareness of stop lights on the vehicle ahead so that you can act instantly when the lights come on. The stop light will inform you the vehicle is slowing down much earlier than you can tell it any other way. If a vehicle gets too close behind you, you would be wise to drop back a little more from the vehicle ahead, to provide more cushion room to prevent the driver behind you from knocking your car into the vehicle ahead, should the vehicle ahead make an emergency stop.

As your line of traffic slows down, as on the approach to a

signal light, you may shorten your following gap. This will be easy to do. Too often it is overdone and a series of rear-end collisions result, especially on wet pavement. As your line of traffic accelerates, as upon leaving a signal light, you should lengthen your following gap as your speed increases. This will be hard to do, unless you are conscious of the fact that an increase in speed without an increase in the following gap is creating a trap for you. In determining a safe following distance you must also consider the number of vehicles ahead of you and the length of the gaps between them, and the number of vehicles behind you and the length of the gaps between them. Three or four vehicles ahead of you too close together and three or four vehicle behind you too close together should be sufficient warning for you to increase your following gap and to be alert to traffic conditions ahead, ready to give slow signals by hand and arm as well as by stop light, and ready to apply your brakes. An ample following gap not only will prevent a collision with the car ahead but also will enable you to avoid a locked wheel stop which would cause the car behind to hit you.

t. When a double yellow stripe divides a street with one lane in one direction and two lanes in the other direction, do not drive to the left of the double yellow stripe.

u. Keep a lookout for left turn signals on meeting vehicles some distance up the street. Lengthen the gap between you and the vehicle ahead when you spot a left turn signal, because the driver signaling may turn left suddenly in front of the vehicle ahead of you. Observe the escape openings available so that if this happens you will have a plan to avoid the cars should they collide. After you increase the gap, look sharp, because the signaling driver may decide to turn across your gap.

v. Look for indications that vehicles may enter your lane from parking zones. Exhaust smoke from an angle zone should alert you to slow down and signal. If a front wheel is turned toward traffic in a parallel zone, you should expect the vehicle to move unless you can see that no one is behind the wheel of the car. If lights are burning on a parked car at night, you should expect the worse. When these warnings appear, check your mirror for traffic close behind you. You may be entering a trap and may need to flash the stop light, give hand and arm signal, slow down, or sound your horn to keep the trap from springing.

w. When a driver you are meeting is signaling for a left turn and you are far enough from the intersection to yield the right-of-way and you start slowing down, it will help to give a slow signal immediately to indicate your intention. This signal will enable the other driver to proceed in his turn without holding up traffic behind him and it will shorten the delay for yourself and traffic behind you.

4. Approaching and Driving Through an Intersection Where There Is No Signal Light, Stop Sign, or Yield Sign Present

a. Approach each intersection at a speed that will enable you to avoid colliding with a vehicle after the sight distance permits you to see it. Sight distance is the distance from the driver's eye to the approaching vehicle on the cross street at the first point where it is possible for the driver to see the vehicle on the cross street.

b. The shorter your sight distance is, the more you will have to reduce your speed. If a blind corner (building, shrubbery, etc.) is present, you may have to reduce your speed to 5 to 10 miles per hour (or even stop) in order to bring your approach speed to a rate that will permit you to avoid a vehicle on the cross street that does not slow down. Collisions in open intersections will never be reduced in number unless more drivers accept and act on this simple fact.

c. When you are approaching an intersection from any direction and a vehicle is approaching from the side at such a distance and at such a speed that the two vehicles are likely to reach the intersection at about the same time, reduce your speed sufficiently to prevent a collision. In case of doubt, let the other vehicle go through first. Assume that the other driver is not going to yield until he indicates clearly by signal or slowing that he intends to yield.

d. When you are approaching an intersection and another vehicle is approaching the intersection from your right and it appears that there will be a collision if both vehicles continue, then you are required by law to yield the right-of-way to the vehicle on your right.

e. If another vehicle is approaching the intersection from your left and it appears there will be a collision if both vehicles continue, the vehicle on your left should yield to you. However, some drivers approaching on the left think that if they speed up and get into the intersection first by a few feet, they have the right-of-way. Therefore, unless the driver on the left indicates by a signal or a reduction of speed that he intends to yield, you should make every effort to stop your vehicle before entering the intersection. Even though another driver should yield the right-of-way under traffic law in this instance, you have a responsibility to do all that you can to prevent a collision.

f. When you are on a single-lane street or a street or roadway of only two traffic lanes, approaching an intersection of a divided roadway or a street or roadway of three or more marked lanes, you shall yield the right-of-way to vehicles within the intersection or so close as to be an immediate hazard. You may only proceed when you can safely enter the intersection without interference or collision with the other vehicles.

g. When you are approaching an intersection on an unpaved street or roadway that intersects a paved roadway, you shall yield the right-of-way to any vehicle on such paved roadway which is within the intersection or approaching in such proximity that it appears hazardous. You may only proceed when you can safely enter the intersection without interference or collision with traffic using the paved roadway.

h. When you are approaching the intersection of a through street or roadway from a street or roadway which terminates at the intersection ("T" intersection), you shall stop and yield the right-of-way to vehicles on the through street within the intersection or to those so close as to be a hazard. You may proceed only when you can safely enter the intersection without interference or collision with the other vehicles.

i. When approaching intersections with a restricted sight distance, hold your right foot over the brake pedal to reduce reaction-time distance in an emergency. When you see that a safe approach to an intersection will require you to slow to a speed under 12 mph, shift into second gear. You will then have more power in an emergency. Even at an open intersection where vision is good, if traffic is heavy and you must decelerate to a low speed, shift to second gear just before you enter the intersection if you are driving a manual shift car.

j. When approaching an intersection where it will be necessary for you to stop, give a stop signal early enough to warn other drivers (at least 100 feet in city traffic) and stop before reaching the nearest crosswalk. If there is no marked crosswalk and no pedestrian traffic, stop with your front bumper back of the cross street curb line.

k. When waiting behind other vehicles, leave a buffer space to allow for a roll back on a grade or to serve as a cushion in case you are hit by another vehicle from the rear. Allow enough space so that you can see the roadway behind the car in front of your vehicle.

l. When approaching an intersection where either street contains four lanes, you should anticipate a special trap which a driver may spring on you by turning from a wrong lane. A driver meeting you may suddenly turn left from the far outside lane. A driver on the cross street may do the same thing. If you are in an outside lane, a driver ahead of you in the inside lane may turn right in front of you. And when you are in the inside lane a driver ahead of you in the outside lane may turn left in front of you. A few drivers actually do not know better. Do not let one trap you.

m. Sometimes the right halves of two four-lane divided roadways join in such a way that it is difficult to tell whether you are "turning off" no matter which fork you take. The traffic volume on each fork may be equal, or the "main" fork, carrying the most traffic, may curve a little more than the fork with less traffic. If you consider the right fork the main road you might turn right from the inside lane and another driver considering the left fork the main road might turn left from the outside lane. The best procedure is to get into the outside lane for the right fork and into the inside lane for the left fork. The next best procedure is to signal well in advance if you are not in and cannot get into the recommended lane. By all means slow down and decide early which way you intend to go. Do not start zig-zag thinking on the approach to one of these intersections.

n. Sometimes a straight two-lane street intersects a side street which forks only to one side at about a 45° angle. The side street that angles off carries a major portion of the traffic, and drivers, therefore, consider it the "main" roadway. First, it should be clear that if there are no traffic control signs or signals at the intersection, the intersection right-of-way laws apply. If you approach this intersection on the straight street intending to go straight ahead, and the fork is on your right, you should yield to vehicles coming into the intersection from your right. If you approach the intersection on the forked street, you should yield to vehicles coming into the intersection on the straight street from your right. Usually drivers approaching an intersection without controls will yield to heavy or fast traffic even though they are not required to do so by law. You should keep the right-of-way law in mind, however, and be prepared to yield, regardless of traffic conditions, should you conflict with a driver who enters the intersection legally.

From a procedure standpoint, a problem arises when you are going straight ahead and the main volume of traffic is going and coming on a branch street that angles off to your right. You should hold to the right side of the center stripe of the side street where it joins the street you are on, while yielding to opposing traffic coming off the side street. You should hold in a position that will leave room for vehicles overtaking you to pass to your right. If the traffic lane is too narrow for this, you should drive to another intersection on the side street and turn left, even if you have to go out of your way.

If you force an opening you will likely cause a collision. Many drivers on the "main" street might like to slow down and let you enter, but after they can see you waiting they do not have time to slow down without causing collisions between vehicles behind them.

The "main" street traffic should be protected at the intersection by a yield sign (or other control), but in some instances the heavy traffic exists only one hour in the morning and one hour in the afternoon. The remainder of the day the traffic flow on the two streets is balanced or might even be less on the "main" street.

If you approach the "main" street when traffic is heavy, you should be as patient as you would be if there were a yield sign

facing you. If a yield sign were present you would simply have to wait until you could enter without interfering with other traffic, period. An alternate procedures is to go another route when you know that the traffic will be heavy on the "main" street at this intersection. Finding a better route that will delay you less and expose you to fewer hazards is always good defensive planning.

o. If in turning left you might conflict with a meeting car turning right, it is safer to yield. The driver may not intend to turn, even though his right turn signal is flashing.

p. When you are on a narrow street approaching an intersection at which you will have to stop to wait for traffic to clear, stop your car five feet back from the crosswalk so that vehicles turning right and left from the cross street into the lane to the left of your car will have more turning clearance. This procedure would apply also to an intersection controlled by a sign or signal.

5. Approaching and Driving Through Intersections Where There Is a Stop Sign or a Flashing Red Light Facing You

a. Give a distinct stop signal soon enough to give adequate warning to other drivers. In city traffic give a signal at least 100 feet before stopping.

b. Come to a full stop at the stop sign or at a stop line marked on the pavement. However, if no stop line is present and there is a pedestrian crosswalk, stop before your front bumper reaches the crosswalk. If there is no crosswalk, stop before your front bumper reaches the curb line of the street or highway you are approaching. If the stop sign is placed within the right-of-way of the highway you are approaching, stop before your front bumper comes abreast of the stop sign. On approaching a stop sign that is located some distance from the cross street roadway, check your mirror and signal well in advance. A driver behind you may not expect you to stop before you reach the roadway.

c. Stop your vehicle to the right of the center of any two-way roadway you are on, whether or not there is a centerline. If you stop to the left of the center you are in a trap for turning vehicles. When a left turn lane is provided, stop within the left turn lane.

Sometimes the right half of a two-lane street is wide enough for two vehicles to stop abreast. When such room is available, do not stop your vehicle in the middle of the wide lane. Stop either near the centerline or near the curb. These positions will permit drivers following you to make left or right turns if traffic should delay your starting up.

When you approach a stop sign intersection on a narrow street and you have to use the middle of the street to get around a vehicle parked near the intersection, you should drive back to the right side of the street before you reach the crosswalk. You will then be in a legal position when you stop. Otherwise you will be close to the path of cars making turns into the block you are in. Here is another example why parking is prohibited within 20 feet of an intersection. The procedure holds whether or not there is a stop sign at the intersection, if there is a chance you will have to stop and wait for traffic on the cross street.

Incidentally, it is illegal to enter an intersection with any part of your car on the left side of the center of a two-lane, two-way roadway. And it is illegal to drive on the left side of such a roadway within 100 feet of the intersection. If a street is so narrow that drivers are compelled to cross the center to get by parked vehicles, then parking should be prohibited within 100 feet of the intersection.

d. Stop your vehicle far enough back from the intersection to keep it out of the path of vehicles approaching from your right and making left turns into the block you are in. If you are approaching a stop sign behind a vehicle that has stopped too far out, stop your vehicle far enough back to permit the vehicle ahead to back up. This courtesy is very important when the vehicle ahead is blocking the pedestrian crosswalk or is in the way of turning vehicles. The driver may have eased out to see.

e. If vision is obstructed in either direction after a proper stop is made, ease vehicle slowly into edge of intersection to a position where you can see the cross street approaches in both directions. However, if you know there is a signal light near by on the cross street and vehicles are approaching from that direction, you may as well wait for several vehicles released by a green light to pass before you ease into the intersection to clear around a blind corner. While easing into the intersection be prepared to hit the brake quickly. Clear, by looking in both directions. Look last in the direction in which your sight distance is shorter (otherwise to your right) before proceeding.

f. If vehicles are approaching, wait until it is possible to enter the intersection without forcing the vehicles to swerve or make abrupt stops. When the street is narrow wait until there is a break in traffic in each direction and accelerate across the intersection. Sometimes a driver will slow down to create a break in traffic for you to cross. Keep alert and be ready to take advantage of this opportunity to cross. If you are unable to sense that a driver is slowing down for you, wait.

g. There are special traps you can easily create for yourself and others when you make turns right or left onto a two-lane street after leaving a stop sign. If you turn in front of a vehicle that will be overtaking you rapidly on the street you are entering and there is another vehicle meeting you on this street, the vehicle overtaking you cannot pass to the left of your car.

Before you make a turn from a stop sign in front of a vehicle and it is likely the vehicle would have to pass you, be sure a meeting vehicle will not prevent the overtaking vehicle from passing you.

h. Where there are two stop signs opposite each other on a cross street and two or more vehicles at each sign are waiting to enter the protected street, the front vehicles may proceed at the same time if both are making left turns; if one vehicle is making a left turn it should yield to a vehicle coming straight through the intersection, but it should have priority to make its left turn in front of a second vehicle coming straight through from the opposite sign; if one vehicle is making a left turn and an opposing vehicle is making a right turn the vehicle turning left should yield to the vehicle making a right turn, if there is only one lane for both to enter. These procedures follow roughly the laws regulating similar vehicle movements, and are subject to width of streets, traffic density on the two streets, and vehicle speeds, any one of which might dictate an alternate procedure that may expedite safer movements of vehicles.

i. Four-Way Stop Signs:

(1) If traffic at an intersection is controlled by stop signs at four entrances to the intersection, the most orderly procedure to follow in leaving the stop signs is for the vehicle that obviously arrived first to leave first. Then the vehicle that arrived second to leave, etc. This procedure is simple courtesy.

(2) If two cars arrive at two stop signs on intersecting streets at about the same time, the driver on the left might yield to the driver on the right. This procedure simulates the open intersection law to which drivers are accustomed and therefore aids in preventing delays.

(3) If traffic is heavy on all approaches priority might be given to commercial vehicles, especially large heavy trucks. If you intend to yield to a vehicle that arrived at the intersection after you did, you may indicate your intention by giving and holding a distinct stop signal with hand and arm.

(4) If traffic is heavy on one street and you are the only driver waiting on the other street, you might yield to two or three cars before you enter the intersection, in order to reduce congestion.

(5) The four-way stop sign intersection presents a procedure problem that does not lend itself to a precise mechanical solution. The best defensive procedure is to yield to a vehicle that is moving inside the intersection legally while you are still stopped. A vehicle is moving legally if the driver stopped before entering, gives proper signals, if required, and is moving in the proper position.

6. Approaching and Driving Through Intersections Where There is a Yield Sign or a Flashing Yellow Light Facing You

a. When there is a yield sign reduce your speed to a rate that will enable you to check cross street traffic in both directions before proceeding into the intersection. Yield the right-of-way to vehicles on the cross street whenever there is the slightest chance that you will interfere with their movement.

b. If there are no pedestrians in the crosswalk and there are no vehicles approaching near the intersection, you may continue past the yield sign without stopping. If you enter the intersection without stopping or if, after stopping, you enter the intersection and are involved in a collision with a vehicle which approached on the protected street, the collision will indicate that you did not yield the right-of-way.

c. A special trap may be created for you by a driver who does not understand the meaning of a yield sign. If you are following this driver, approaching a yield sign where your sight distance permits you to see there is no traffic nearby on the protected street, you may rightfully assume that the driver ahead will continue by the yield sign without slowing or stopping. Some drivers who do not understand the purpose of the yield sign may come to a stop just as they would at a stop sign. You should anticipate this error. You can increase your following gap and be ready to signal drivers behind you.

d. A flashing yellow light is a signal for you to enter the intersection with caution. When approaching the intersection you cannot always know the type of control facing drivers on the cross street. There may be a flashing red light, a flashing yellow light, or no control whatsoever. A defensive driver will assume there is no control facing the driver on the cross street and be prepared to yield the right-of-way.

7. Approaching and Driving Through Intersections Where There is a Stop-and-Go Light Present

a. When the light is not operating at all, follow the procedure suggested for driving through an intersection where there are no control devices. If the light facing you is out, check movement of cross traffic or check light on the cross street, if visible, before you enter the intersection.

b. When the red light alone is showing, give the proper signal and come to a stop behind the nearest crosswalk. If desiring to continue straight ahead, wait until the green light shows before proceeding. Unless prohibited by traffic signs, after yielding right-of-way to pedestrians and to other traffic lawfully using the intersection, you may then turn right or if the intersecting streets are both one-way streets you may then turn left unless prohibited by traffic signs.

c. When the amber light is showing, give the proper hand signal and stop behind the nearest crosswalk, if it is possible

to do so without stopping so suddenly as to endanger vehicles behind you.

d. When the green light is showing, reduce your speed to such an extent that you can stop behind the nearest crosswalk without locking your brakes should the light change to amber before you enter the intersection. If the light changes to amber when you are just entering the intersection, or after it is too late for you to stop behind the nearest crosswalk without locking your brakes, proceed through the intersection cautiously. The longer the green light has been on while a driver is approaching an intersection, the more likely the driver will meet with trouble if he attempts to beat the light by accelerating. The defensive driver watches the green lights ahead. If a light he is nearing has been green for some time he will give a slow signal to warn the driver behind that he may stop at the intersection. Then if the light is still green when he is about 40 feet from the intersection, he can accelerate. If you are two blocks away when you first see a green light you will be wise to decide not to try to make it.

e. When the green light shows, proceed through the intersection, yielding the right-of-way to pedestrians or vehicles which have not cleared the intersection. You must yield to a vehicle which entered the intersection on the cross street to make a left turn and could not complete the turn until the light changed. Give attention to the light and be ready to start when the green light shows (if the way is clear) so as not to delay the vehicles behind you. A "slow starter" at a signal light is a traffic nuisance. A driver who does not keep his eyes on the signal light with his car ready to go may cause several drivers behind him to have to wait through another cycle of the light. Use of horn is permitted only to insure safe operation. Its use to alert show starters at signal lights may be justified because it is illegal and unsafe to let a vehicle stand in the roadway after the green light shows, unless the driver is waiting for a vehicle or pedestrian to clear. The driver of a standing vehicle is responsible for clearing the lane for vehicles overtaking him. The horn is a warning to help you clear the way. If you use it for this purpose, tap it early and gently instead of late and loud. If the horn is used on you, just remember that slow starters create annually a sizeable economic waste in time and fuel.

f. When you drive on a street where signal lights are timed progressively for a given rate, it is advantageous to maintain a constant speed. Fast spurts between progressively timed signals are hazardous because other drivers become distracted or confused. Your engine consumes more gasoline due to numerous stops and the use of lower gears, and the extra braking increases wear on brake linings. If you frequent a street with progressive signals, you should note the speed at which you can travel without stops and try to maintain this speed, if safe.

g. When you are approaching an intersection signal that shows a red light facing you, and a left turn green arrow facing traffic meeting you, this traffic can make left turns in front of you. However, the drivers seeing you approaching but not knowing you face a red light may hold up traffic unless you let them know that you intend to stop.

h. When you are approaching a green light behind a large vehicle which obstructs your view of the green light you cannot depend upon the lights facing cross street traffic to inform you that your light is still green. Your light may be on amber while red lights still show on the cross street. The red lights facing the cross traffic will probably turn from red to green without showing the amber phase. The fact that some nonuniform lights do show an amber phase all around the intersection may mislead you to enter the intersection on a red light. Wait until you can see the signal light facing you before following a big van across an intersection. The van may be in the intersection when the red light comes on. If you follow the van blindly you may be entering the intersection against a red light.

i. Modern traffic controls at some intersections are complicated. Not only should you depend upon the signals facing you but also you should look for a green arrow signal or a sign suspended over the middle of a lane, or a pavement marking that directs traffic in your lane. A green arrow located at the far right-hand corner of an intersection or over the center of a street gives directions and you select the proper lane according to the regular lane laws. Never conclude that you may proceed simply because a red light is showing on a cross street. And do not start up just because vehicles beside you start moving.

j. If you approach an intersection in a lane restricted to left turns when you desire to go straight, you should make the left turn. If you approach in a lane that permits only straight ahead movements, do not make the mistake of trying to turn left. A restricted right turn lane may require the same procedure. Thousands of dollars have been spent to help you get through the intersection safely. If you make an error in selecting the correct lane, do not compound your mistake by making a worse error in violating lane instructions. Follow the lane instructions and thereafter give more attention to planning ahead.

k. When facing a red light with green arrows and there are no special lane signals, you may move only in the direction a green arrow points, provided that if you turn, you are in the proper position.

When green arrows on a four-lane street at an intersection direct traffic to go straight ahead or turn right, ordinarily you should not stop in the inside lane and wait for a circular green light in order to make a left turn. At some intersections left turns may be prohibited altogether and a green light or a left turn green arrow may never show. When a green arrow per-

mits a right turn on a red light, you should not stop in the outside lane and wait for a circular green light in order to go straight ahead. Such stops are discourteous where drivers behind you want to move on the green arrows. Sometimes signs will prohibit these stops where they would cause congestion in heavy traffic.

l. Traffic control devices, such as signal lights, lane signs, and stop signs, are designed to make it easy for drivers to travel safely in heavy traffic. However, they are designed to serve the greatest number of drivers under normal traffic conditions. The devices do not always serve as efficiently under peak traffic volume loads. Nor can the devices serve the whims of individual drivers. Remember these facts when you feel prone to violate a traffic control just because it may be safe to do so at a given time. If it were left to the individual driver to decide in every instance whether or not he should comply with a control, no one could depend upon a stop sign or a stop-and-go signal light to protect him. Some drivers, of course, do not accept their responsibility in sharing the use of public streets. Enforcement is necessary to increase the protection of all drivers which traffic control devices are designed to provide.

m. If you experience delays and special traffic problems during your routine driving in a city, you might alter or vary your routes or parts of your routes at different hours of the day to make your driving time shorter or your driving safer and more pleasant.

If you are being delayed in congested traffic going to and from work, consider changes in the routes you are traveling or changes in your departure time. Starting five or ten minutes earlier may lessen traffic congestion considerably for you.

n. A four-lane divided street that has a dividing strip 30 feet or more wide forms two intersections with a cross street. If the two intersections are signalized, a driver approaching on the cross street will be facing two signal lights about 75 feet to 100 feet apart. If the signal lights are suspended over the centers of the two intersections and green phases of the two lights are not set to come on at the same time, an inattentive driver may drive into the first intersection against a red light. The green phase of the far signal may come on a few seconds ahead of the near signal. The driver's view of the near signal may be obstructed by the top of the driver's car if the driver is waiting close to the intersection. When the driver sees the far signal turn green, he may assume the near signal is green also (or forget that it is there) and drive himself into trouble. When you approach a double intersection such as this, note whether or not there are two signal lights. If there are, keep your attention directed at the first signal. Start only when the first signal is green and then direct your attention to the second signal, which may or may not be green when you arrive at the far intersection.

8. Approaching and Driving Through Intersections Where There Is an Officer Present Directing Traffic

a. Reduce speed, giving the proper signal to indicate that you are slowing down. Look to the officer to see what he is directing you to do, even though signal lights may be working, and follow his directions.

b. If you want to turn and are in doubt as to whether the turn will be permitted, indicate your intention by giving the proper signal; if necessary, call the officer's attention by sounding the horn lightly. he will probably indicate by a hand signal whether you should stop, proceed to make the desired turn, go straight through, or turn in some other direction, as the needs of the traffic situation may require. An officer's directions supercede all traffic signs and signal lights, but his signals do not relieve you of the responsibility of avoiding collisions with vehicles or pedestrians.

c. Follcw the directions of the officer without question, realizing that he tries to make his decision so as to make it possible for the greatest number of drivers to go where they want to go by the shortest route and with the least possible inconvenience. Do not stop in the intersection to ask an officer who is directing traffic for route information. The officer may be there to prevent traffic snarls; your stopping will not help much.

9. Blocking Traffic Within Any Intersection

a. When you plan to go straight through an intersection beyond which traffic is congested, stop before entering the intersection to avoid blocking traffic on the cross street. When there is enough space in your lane for your car beyond the far crosswalk, you may proceed.

b. If the intersection is signalized you would not be blocking cross traffic until the light changed, but you should not enter on the green light to go straight through unless it is obvious that there will be enough room ahead for you to get out before the red light comes on. Furthermore, you might block the path of meeting vehicles turning left if you move into the intersection on a green light and have to stop. Therefore, if you enter an intersection on a green light in a congested lane you should be able to cross before the red light shows, and you should be able to wait in a place where you would not obstruct the path of a meeting vehicle turning left while the green light is on.

c. If you plan to turn left at an intersection where the opposing traffic lane is congested you may move into the intersection to hold. If it is apparent that the opposing traffic lane will be blocked for some time you should proceed straight through, unless vehicles behind you can go around you on the right. If you are on a four-lane roadway and traffic is heavy in

both right side lanes, you should not congest the inside lane waiting for a jam in one of the opposing lanes to break up. A jam in an opposing lane may have been caused by a driver holding for a left turn at the intersection behind you. You and one other driver would be jamming two inside lanes of a four-lane roadway. If traffic in the outside lane on your side of the street is so heavy that vehicles behind you in your lane cannot feed by you in the outside lane and either of the opposing lanes is blocked, you should move on straight across the intersection.

10. Turning Errors That Are Common

a. Improper position of vehicle on the approach to a turn:

(1) Failure to maneuver your vehicle into the proper position or lane for the turn early enough to indicate to pedestrians or drivers (front, rear and side) that you are intending to turn.

b. Failure to give a distinct turn signal early enough for pedestrians or drivers to react and maneuver to help you make the turn safely.

c. Unsafe speed of vehicle on approach for a turn:

(1) A fast approach will indicate to other drivers that you do not intend to turn. The other drivers may become confused and will not be able to maneuver properly to help you make the turn safely.

(2) If approach speed is too fast for a right turn, you may be forced to make a wide right turn across the centerline on the cross street.

(3) If approach speed is too fast for a left turn, you will be forced to cross the centerline before you reach the intersection or you may be forced into a vehicle parked at the curb on the cross street.

d. Approaching an intersection for a left turn and failing to yield the right-of-way to a vehicle coming straight through the intersection, when the vehicle is too close to slow down safely.

e. Approaching an intersection to go straight through and failing to slow down to let a meeting vehicle, waiting to make a left turn, proceed, when slowing down a little would provide ample time for the vehicle to turn left.

f. Driving to left of the centerline on the approach to a left turn at an intersection or at a private driveway.

g. Failure to wait for opposing traffic to pass before turning left into a private driveway.

h. Driving on left side of street on approach to a right turn into a private driveway.

11. Turning Right

a. Get into the right-hand lane for a right turn. If there is only a single lane, maneuver your vehicle to the right portion of the lane well in advance of the turn, preferably a third of a block. As you near the intersection, ease over closer to the curb if there is traffic behind you so that vehicles going straight may proceed to the left of your car before you start the turn. On a four-lane street try to get into the correct lane by midblock. If traffic is heavy, you should begin looking for an opening to change lanes over a block away from where you plan to turn.

b. Give a distinct right turn signal for at least 100 feet before beginning the turn maneuver if movements of pedestrians or vehicles approaching from any direction might be affected.

c. Enter the intersection at 5 to 10 miles per hour and turn into the cross street on the right-hand side of the center of the cross street. If the cross street has four lanes turn into the outside lane. This procedure leaves the faster inside lane free for vehicles making left turn onto, or overtaking you on, the cross street.

d. If the right turn is sharp or if there is traffic behind you on the cross street, you should make the turn and accelerate quickly to the normal driving speed for the area.

e. If traffic behind you is fairly swift with a vehicle close and you have a standard transmission, shift to second gear about 50 feet from the turn, keep the clutch depressed, and brake so as to reach a safe turning speed just as you reach the intersection. Engage the clutch in the turn and accelerate.

f. Drivers hit curbs on right turns usually because they turn about two feet too soon or they turn too slowly for the speed of the car. They turn too early because they do not realize that the front wheels are located about a yard from the front bumper, and the long hood makes them feel that the front wheels are into the cross street farther than they are. Drivers make right turns too wide usually because they are going too fast or they do not turn the wheel fast enough for the speed of the car. They may turn the wheel too slowly because they do not have their hands in positions on the steering wheel that will enable them to exert enough leverage for fast turning. For fast turning move the left hand to 4 or 5 o'clock position. Initiate the turn by pulling down with the right hand and pushing up with the left at the same time. Bring the wheel on around with the left hand and "walk" with the right. This method is useful when you need to escape fast traffic close behind you. Alternate pulling on one side of the wheel and pushing on the other is a poor steering procedure for making sharp turns accurately. As you come out of the turn, return the wheel to normal driving position.

g. Do not steer away from the curb toward the middle of the street on the approach to a right turn. Such an approach is not necessary at an intersection turn. It is both illegal and confusing to other drivers. A novice driver usually makes this error because he has not had skill exercises on close-in maneuvers. This lack of ability to judge where the right side of his car is will cause this driver to shy too far from a car he is overtaking and passing on a rural road. This shying has caused drivers to run off the pavement with their left wheels, lose control of their cars and overturn, or oversteer to recover and sideswipe the vehicles they are overtaking.

h. Another error of the novice driver is to stop, or almost stop, when he is half way around the corner on a right turn. This trick has caused many a rear-end collision. The driver who does this may need practice on close-in maneuvers or he may need to get into second gear as he approaches the corner. There are so many drivers who cannot make right turns properly that a smart defensive driver will, upon seeing a right turn signal ahead, give a slow signal, if there is traffic behind him, and slow down early in preparation for a quick stop.

12. Turning Left From a Two-Way Onto a Two-Way Street

a. In making a left turn, give signal and approach just to the right of the centerline (or center of the street if it has no centerline) and enter the cross street to the right of the centerline of the cross street. If you are entering a four-lane street, you may enter either of the two right side lanes, depending upon which position will create less congestion for vehicles that will be overtaking you on, or turning right into, the cross street. By observing the positions, types, and speeds of these approaching vehicles as you enter the intersection, you can determine which lane to enter.

b. You should always turn sufficiently wide to leave enough room to your left for a vehicle meeting you (from the cross street) to make a right turn safely.

c. If the street you are leaving is four-lane, two-way, you will have to turn left across two lanes of opposing traffic. An opposing vehicle turning left will have the inside traffic stopped but a vehicle coming straight through in the outside lane presents a hazard for you. Second, you may be so intent on looking for an opening across the outside lane of traffic that you may forget to check the crosswalk on your left rear for pedestrians, who may get to the center of the street just as you accelerate in low gear through a break in the opposing outside lane traffic. You should check for both hazards before you start the left turn.

d. When you must wait for traffic to clear before turning left, you may pull out into the intersection, but do not cross the centerline until you can complete the turn. Keep your front wheels straight, so that in case you are struck from behind your car will not be knocked into the path of opposing traffic. Keep your foot on the brake pedal until the way is clear for you to turn.

e. In waiting to turn left always stop your car far enough into the intersection to permit vehicles behind you to pull around you on the right to make right turns or to go straight through.

f. On entering an intersection for a left turn from a stop, a driver with a standard transmission will find it advantageous to shift to second gear before making the turn. He will then have power both to maneuver at low speed and to accelerate quickly on the cross street. And he can have both hands on the wheel during the turn. However, a cross street might be so narrow that it would be better to execute the turn in low gear. Students should have practice in the low gear turn onto a narrow cross street, from a stop outside the intersection.

13. Turning Left from a Two-Way Street onto a One-Way Street

a. In making a left turn onto a one-way street, give a left turn signal at least 100 feet from the intersection and **start** the turn as described in left turns from a two-way street onto a two-way street. However, after the turn is started from the proper position, turn sharply to the left and, if possible, enter the extreme left-hand side of the one-way street. At some signal light intersections, pavement markings may permit you to turn left into two lanes of the one-way street. At such an intersection traffic from your right would be stopped by a red light and you would not be crossing a line of traffic by turning left into the second or third lane.

b. If the street you are leaving is two-lane and narrow, and you have to wait for opposing traffic, you should pull into the intersection far enough to permit straight through traffic behind you to pass you on the right. If your stopping would stop all traffic behind you, you should proceed to another street to turn left.

c. Before leaving the right side of the street you are on, in making a left turn from a two-way street, look to your left for a pedestrian who might be in the crosswalk to your left. If a pedestrian is crossing (in your direction) on this walk, he may force you to stop in the path of vehicles you are meeting. You should see that this crosswalk is clear before leaving the right side of the street. You must yield the right-of-way to a pedestrian in any crosswalk unless the pedestrian is crossing against a red light. If an adult pedestrian stops midstreet and obviously indicates his intention to yield by signal or otherwise, you should proceed slowly and only when you know opposing traffic will not endanger him. Another hazard you must check is an opposing vehicle making a right turn in the direction you are turning.

14. Turning Left from a One-Way Street onto a One-Way Street

a. When leaving a one-way street and entering another one-way street, give a left turn signal at least 100 feet from the intersection and drive into position on the extreme left-hand side of the street near the curb or parked vehicles. Turn sharply to the left and enter the extreme left-hand side of the cross street. In heavy traffic you should start maneuvering to the left side at least a block from where you intend to turn. You should signal and look to the left before each lane change during this maneuvering.

b. If traffic is light, it may be possible to maneuver from one curb lane to the other curb lane of a one-way street within the distance of one block. The only restriction is that you signal and clear each lane before entering it. You should keep a directional signal flashing throughout these maneuvers. You should not, however, congest traffic in any lane by creeping along waiting for an opening in an adjoining lane. Condition yourself to change your plans quickly when you discover the plans will create congestion or hazards.

c. Local signs, signals, or markings at an intersection may permit you to turn left from either of two lanes and enter either of two lanes on the cross street. If you start a turn in the left curb lane you should enter the left curb lane on the cross street. If you turn from an inside lane, enter the corresponding inside lane on the cross street. These procedures will permit two lanes of traffic to turn left without conflicts.

When a left turn from a one-way street is permitted from either of two lanes, and you are going straight ahead, you should avoid approaching the intersection in the curb lane, because you would conflict with cars turning left from the inside lane in front of you.

15. Turning Left from a One-Way Street onto a Two-Way Street

a. On leaving a one-way street and entering a two-way street, give a left turn signal at least 100 feet before the intersection and drive over to the extreme left-hand side of the one-way street. Turn left sharply just beyond the middle of the two-way street you are entering and drive to the right of the centerline. You may enter either of the two right-hand lanes on a four-lane street. You should enter the lane in which you will interfere least with vehicles which will be overtaking you or be turning right in the direction you are going.

b. Local signals, signs, or markings may permit you to make this left turn from either of two lanes. You then should approach in an inside lane and turn into an outside lane and vice versa, unless changing lanes in the turn would not interfere with other vehicles.

16. Turning Right or Left onto a Four-Lane Street

a. When you make a right turn onto a four-lane street you are required by law to turn into the street as near to the right-hand curb as is practicable. This requirement restricts your right turn to the outside lane, unless, of course, movement in the lane is obstructed for some reason.

b. When you turn left onto a four-lane street you are permitted to enter either the inside lane or the outside lane. A question that often arises is why an option of lanes is permitted on a left turn but not on a right turn.

c. A right turn requires a slower speed than a left turn. On the right turn the outside lane which you enter first is usually the slower lane. If you were permitted to enter the faster inside lane, you would be crossing the slow lane to get to the inside lane where you would slow down the faster traffic. Furthermore, you would interfere with faster vehicles making left turns into the inside lane.

d. When you make a left turn you have to cross the faster lane to get into the slow lane, but once you are there you are in the safer lane for accelerating. You not only can make a left turn faster than a right turn but also you can turn left into the outside lane faster than you can into the inside lane. So, you are entering a slow lane faster instead of a fast lane slower. If there is traffic approaching in the inside lane you will interfere with it less by going straight to the outside lane than you would be accelerating in the inside lane. On the other hand, if the outside lane should have more traffic than the inside lane when you turn, or if the traffic is closer in the outside lane, or if vehicles are making right turns into the outside lane, you would interfere with traffic less by turning into the inside lane. These dual advantages are not present in the right turn.

17. Turning Left Midblock across Double Centerlines or No-Passing Zone Line

a. These barrier lines prohibit driving to the left of them either in cruising or in overtaking and passing other vehicles. It is legal to cross these lines for the purpose of turning left into a private driveway, however, any left turn is illegal if the turning movement interferes with meeting vehicles in any way. This law, regulating a left turn in midblock, applies regardless of the type of centerline. It applies whether or not there is a centerline marking. A left turn across a double line or a no-passing line, therefore, is illegal anywhere if there is any meeting traffic close by and you cause any interference to such traffic.

b. The State Department of Highways and Public Transportation has defined the purpose of these lines on state and federal highways and stated that the intent was to prohibit driving in a lane on the left side of the lines and not to prohibit making a left turn across the lines when the turn could otherwise be made legally.

c. A city ordinance may specifically prohibit left turns midblock across these lines and it is the responsibility of a driver to find out whether a city ordinance prohibits the left turn.

18. Crossover Movements on a Four-Lane Divided Roadway

a. If you are turning left onto a four-lane street that is divided by a median strip wide enough to clear your vehicle from traffic on both sides and you have to stop before entering the far side, always position your vehicle so that neither end will project into a traffic lane and congest traffic. The same precaution should be taken in making U-turns at a crossover or in going straight across at an intersection.

b. If the median strip is not as wide as your vehicle is long, you should angle your vehicle in a crossover in a position that will permit other vehicles to pass through or stop in the crossover beside your car.

c. Positioning a car in a crossover is a good example of how skill exercises apply to driving problems. A car stopped about half way into a crossover blocks an entire taffic lane. Usually this error is caused by a driver who cannot judge where the ends of his vehicle are in relation to the curbs of the median strip. If you cannot properly position a car in a crossover, you should never stop a car in one when traffic is heavy.

19. U-Turns on City Streets

a. U-turns increase congestion and exposure to collision where there is much traffic and therefore are usually prohibited in downtown business areas either at intersections or at midblock, even though there are no signs posted. U-turns are more dangerous than left turns. Where a left turn is prohibited, of course, a U-turn would be illegal. Often a NO U-TURN sign will be located at a place which appears safe to drivers but for some reason is not. Where a left turn is prohibited you will find a NO LEFT TURN sign.

b. A U-turn on a two-lane street at an intersection should be executed in two parts. First, give a stop signal, drive to the far right-hand corner of the intersection, and stop near the curb corner with the car angled to the left just enough to make it easy to clear to the rear by looking out of the driver's window. Second, clear in all four directions and give a turn signal if there are vehicles approaching. If vehicles are not close and pedestrians are not in your way, complete the U-turn slowly in one maneuver, in low gear. Be ready to stop as you start back across the cross street, because a vehicle you did not see at the stop may be close to the intersection. This vehicle may come out of a driveway or leave a parking stall after you clear traffic at the stop.

c. A U-turn on a four-lane street may be started as described for a two-lane street (stopping at the far right-hand corner of the intersection) and completed by driving into the inside lane on the opposite side of the street. Or, the U-turn may be started from the inside lane as you would approach the intersection for a left turn and completed in the outside lane on the opposite side of the street. In the latter procedure, you should give a slow signal, shift to second gear, and move slowly to the center of the intersection. Check for traffic right, left, and ahead and give a left turn signal before starting the turn. Do not start if vehicles are near, because there is no way for you to signal for a U-turn. Drivers may have planned movements on the assumption that you intend only to turn left.

d. Avoid U-turns on any street where traffic is heavy. Go around the block.

20. Overtaking and Passing on a Two-Lane, Two-Way Street

a. Drive near but not on the center stripe until it is possible to get a clear view beyond the vehicle to be passed. Look ahead and make sure that:

(1) You can complete the pass and still leave at least 200 feet between your car and opposing traffic when you return to the right side of the street.

(2) You can get back on the right side before you reach a no-passing zone or a point 100 feet from the near side of an intersection, a railroad grade crossing, a bridge, or a tunnel.

(3) No vehicle is backing from a private driveway, leaving a parking zone, or making a right turn in your direction at an intersection. The right-of-way may favor you in the first two instances, but it will be against you in the third instance. This is one reason driving on the left side of a roadway near an intersection is prohibited.

(4) The driver of the car ahead will not turn left into a private driveway. His intention to turn may be indicated by a hand signal, a directional signal, his slowing down, or his gradual turning toward the centerline.

(5) The driver of the car ahead will not suddenly cross the centerline to avoid a vehicle on his right that is backing, stalled or double parked.

(6) A truck you are overtaking does not obstruct your view of a vehicle that may be entering your street from a

right side T-intersection or of a pedestrian crossing from the right in midblock in front of the truck.

b. Look in the rearview mirror to make sure that a following car is not starting a pass, and look to the left if a following car has disappeared from your mirror. Look left for a vehicle that may have already been in the blind area created by your car when you checked the mirror last.

c. Accelerate in your lane before starting to pass and give a left turn signal before crossing the centerline if other traffic might be affected.

d. Sound the horn if necessary to insure safe passage. This signal requires the driver you are overtaking to give way to the right and not increase his speed. You will need all the help you can get in order to make legal passes in city traffic.

e. If, after pulling to the left of the car you intend to pass, you discover that the pass cannot be made you should fall back to the right side of the roadway and drop back an extra distance (in city traffic) before starting the pass again. This maneuver will give you a longer sight distance around the vehicle in front and also will allow you room to accelerate before starting a pass.

f. Make sure that the overtaken vehicle is completely passed by checking it in the rearview mirror or looking to the right before cutting back to the right.

g. Drive back to the right-hand lane immediately but gradually. In making an abrupt turn back to the right you might cause your vehicle to skid, especially on wet pavement. If you accelerate as you turn back on a wet pavement, you can easily go into a good skid and broadside down the roadway. Don't do it near bridges.

h. Overtaking is more hazardous on wet pavement. The amount of turning and the possible braking (if you come out of a pass into a slight right-hand curve), which may be required in a normal pass on dry pavement, can cause your vehicle to be thrown into an uncontrolled skid on wet pavement.

21. Being Overtaken and Passed on a Two-Lane, Two-Way Street

a. If you check your rearview mirror frequently you should not be surprised by an overtaking vehicle. Check your mirror at least once in every block.

b. When you detect a driver trying to pass, cooperate by giving way to the right side of your lane and hold a constant speed, whether he sounds his horn or not. You may decrease your speed but you must not speed up as long as the driver is trying to pass.

c. If you see hazards ahead which might be hidden from view of a driver who is overtaking you to pass, you can warn him by flashing your stop light. If he continues to pass, you should give him all the room you can and slow down to keep your car away from the hazard.

d. If you see that the overtaking vehicle will be trapped by an oncoming vehicle, quickly check your mirror, give stop signal, and slow down if you can do so without endangering traffic behind you. This defensive action may save the trapped driver and possibly prevent the meeting driver from crossing into your lane. If the meeting driver sees that the trapped driver can get back to the right side, he may brake and stay on his side. As a last resort you might be able to duck into an open curb area and turn the roadway over to the other vehicles.

e. If a driver behind you keeps trying to pass when traffic conditions make a pass unsafe, you can avoid the problems if you slow down and assist him in passing.

22. Overtaking and Passing on Multilane, Two-Way Streets

a. You may overtake and pass either to the left or to the right.

b. Keep your car in the center of your lane while overtaking, when the vehicle you are overtaking is in the center of its lane. If the vehicle is riding the lane line, you should give way within your lane in order to maintain a safe distance between the vehicles. A light tap of the horn will alert the driver if you think he does not know you are going by him. When you tap the horn you should be near enough on his side that he will have no doubt whether you are behind him or in a lane beside him. If he thinks you are behind him he may pull over into your lane.

c. Precautions that will aid you in preventing a collision should the overtaken vehicle suddenly enter your lane:

(1) Check you mirror for traffic behind before you start to overtake, and if a vehicle is close, be prepared to give a hand and arm stop signal quickly.

(2) Be prepared to brake quickly. The degree of braking will depend upon how close a vehicle is following you.

(3) Be prepared to signal with horn and to give way in your lane.

d. If you are overtaking to the left on a four-lane, two-way street divided only by a double centerline, do not cross the centerline. You do not have any right to cross a double line in a pass, as you have to cross a single line dividing a two-lane street.

e. If the outside lane is occupied by vehicles traveling slower than you wish to go and the inside lane is congested by a

driver traveling under the speed limit, you may sound your horn for this driver to give way. On hearing your signal this driver should either accelerate to the speed limit or move into the slower lane to let you pass. If he does neither, you will have to wait for an opening to pass this traffic nuisance on the right.

f. When overtaking in the right lane you should avoid using your horn except in an emergency. Many drivers for years accustomed to giving way upon hearing a signal on a two-lane road might through habit pull into your lane.

g. Overtaking to the left of a vehicle approaching for a left turn off a **one-way** street: The laws of some states do not require a vehicle to use the extreme left-hand lane in making left turns off a one-way street onto a two-way street. When you are overtaking in the left lanes of a one-way street, you may expect a driver you are overtaking to turn left in front of you. While he is required to give a signal and clear before moving into your lane, he may fail to signal. Keep an eye on vehicles to your right as you approach intersections on a one-way street.

h. You may change lanes to make consecutive passes right or left around vehicles in two lanes of traffic that may be moving under the speed limit. It is, however, important that you delay between lane changes sufficiently (1) to give distinct turn signals to other drivers and give the drivers time to react to your signals, (2) to look for traffic in the adjoining lane, and (3) to change lanes only when there is a safe gap between a vehicle ahead of you in your lane and a vehicle on your side in the adjoining lane. These three precautions make up the difference between "weaving in traffic" and safe driving.

i. While you may overtake at an intersection on a four-lane roadway, a special hazard may develop when you are driving in the inside lane overtaking a large truck that is in the outside lane. The large truck will obstruct your vision of a car approaching the intersection from your right. This car may have time to cross the lane in front of the truck yet may be hit in your lane by your vehicle which is traveling faster than the truck. When it appears that you will arrive at an intersection just ahead of a truck that obstructs your view, slow down and let the truck run interference for you as you cross the intersection. You cannot, of course, do this on a two-lane road, because it is illegal to drive on the left-hand side of a two-way roadway going through an intersection. When a person states that it is illegal to overtake and pass at an intersection, at a railroad or on the approach to a bridge, what he should say is that it is illegal to drive on the left side of a two-way roadway at these places. If there are two lines of traffic in one direction, as on a four-lane roadway, a driver can overtake and pass at these places without driving across the centerline.

j. A similar hazard may develop when you are in the outside lane. A big truck ahead of you and in the inside lane will obstruct your view of a meeting vehicle turning left across your lane. The operator of the truck may be holding for a left turn or he may have signaled the meeting vehicle to make a left turn in front of him. You cannot know whether either of these things has happened. Slow down as you enter the intersection until you can see the area in front of the truck.

23. **General Parking Rules**

a. When you park at a curb, park parallel to the curb unless the street is marked for angle parking. The law requires you to have a front wheel and a rear wheel within 18 inches of the curb. It is better to have the wheels within 6 inches of the curb. You then will be giving more roadway space to hundreds of drivers of moving vehicles, who will need it more than you will on foot. In addition, your car will be less exposed to collision. Parking over 18 inches from a curb is selfish as well as illegal. Parking under 12 inches from a curb is a good example of courtesy.

b. Always set the hand brake, stop the engine, and remove the keys. In a majority of all automobile thefts, the drivers invite theft by leaving car keys in parked cars. Furthermore, the keys invite children to start the engine.

c. To protect the car or contents from theft, lock the doors.

d. Downgrade, cut front wheels toward curb. Upgrade, car would roll less if wheels are cut away from curb, provided car is close to curb and wheels are cut enough. When there is no curb, cut wheels toward the side of the highway or street. If your brake fails or children release it, your car will roll away from traffic. If the grade is steep, chock the wheels with a rock, or a 4 x 4 block if you carry one in your car.

e. Cars should be left in "park" or "reverse" gear to prevent rolling away, should the brakes give way. Some late model vehicles require that the gear be in "park" or "reverse" before the key can be removed and steering and transmission locked to prevent thefts. Many cars are equipped with a sound alarm that operates when the door is opened while the key is still in the ignition. Your park or hand brake should be used in addition to your gears.

f. Get out of the car on the curb side when parked parallel especially where traffic is heavy and lanes are narrow. If you must leave a car on the traffic side, look back out of the window **before** you open the door, and step out forward. A habit of stepping out forward will force you to face traffic approaching from the rear. A habit of opening the left door with the right hand will help you step out forward.

g. When you stop for parallel parking and there is traffic behind you, give a hand and arm stop signal early. You might motion the traffic around you. If you will wait behind a stall for a car to pull out and then move into a parking position, you

would protect the car leaving and let it enter traffic without having to use another lane to get around you.

h. When a vehicle is stopped beside a parked vehicle just beyond a vacant parallel parking stall, in preparation to park, you should never try to drive head-on into the stall.

i. Sometimes a car will stop a few feet beyond a parallel stall to let a vehicle in the stall have room to leave. The car waiting in the traffic lane has priority over you and you should not pull in behind the waiting car in an attempt to obtain the stall.

j. To have priorty for an angle parking stall you should stop before you get to the stall. While you may back up to get in position to enter an angle parking stall which is being vacated or which you may have overshot, you should not expect priority over a driver behind the stall. And you should not attempt to back up if traffic behind you is congested. If you overshoot an angle stall and a driver behind you wishes to enter the stall from a proper position, you should yield the stall and drive on.

24. Parallel Parking

a. Drive directly into the empty space if there is room to do so.

b. If there is only a one-car space vacant, a good procedure is to back in as follows:

(1) Drive up parallel to and even with the vehicle ahead of the empty space and about two feet away from the vehicle. Note how far the vehicle behind the stall is from the curb.

(2) Look back to see that the empty space is still clear of pedestrians, bicycles, etc. Sound your horn if a pedestrian is in the area.

(3) Turn the front wheels sharply to the right as you back up. Move slowly until your right front door hinge passes the back bumper of the vehicle ahead.

(4) Look to the rear out of the driver window, and as your left rear fender reaches a point in front of the left fender of the vehicle behind, cut front wheels left so as to bring the left side of your car in line with the left side of the vehicle behind. (If the vehicle behind is parked 18 inches from the curb, maneuver your vehicle so as to bring its left side a few inches inside the left side of the vehicle behind. By checking the vehicle's distance from the curb when you start parking, and by following this rear fender guide, you should be able to position your vehicle 6 to 12 inches from the curb.)

(5) As you cut wheels left, check clearance between your car and the vehicle ahead. Ease your car back into the stall with the right side of your car positioned as indicated in (4).

(6) Drive forward or backward until the stall space ahead of and behind your car is fairly well balanced.

(7) If you hit the curb before your vehicle is far enough back in the stall to park properly, you should pull out and start over. If you strike the curb at the end of the stall and there is room to pull forward, cut front wheels to the right as you drive forward until vehicle is parallel to curb. If this move does not space your car properly, straighten out the front wheels as you back into final position.

(8) When you turn a front wheel spindle toward the rear, you actually jack up the front of your car slightly due to the inclining of the top of the spindle pin backwards to create castor. This is one reason parking is tiresome. The turning will be easier if you will have the car moving (even slightly) when you turn the wheels.

(9) The most difficult part of parallel parking is coordinating the rate of turn of the steering wheel with the rate of motion of the car. The distance you stop your car from the vehicle in front of the stall before you start parking may vary from 2 to 3 feet. The shorter the stall is, the farther your car should be from this vehicle when you start backing. However, you can compensate for variations in this distance by changing the ratio of wheel turn and car movement. When you hit the curb, you turned the wheel too fast for the car movement or you waited too long to reverse the wheel. When you end up too far from the curb, you turned the wheel too slowly for the car movement or you reversed the wheel too early.

25. Angle Parking

a. Drive in toward the curb at the angle indicated by the guidelines on the pavement. Do not make a turn across the center of the street to line up with the stall. Simply drive forward about 2 feet farther than you think you should and then turn sharply to the right as your car moves slowly. Check parked cars for occupants who may open a door in front of you.

b. Try to stop your car parallel to the guidelines and in the middle of the zone. A driver who occupies parts of two stalls when two full stalls are vacant is a traffic nuisance.

c. Bring your car almost to a stop just before it reaches the curb, and allow it to roll gently the last few inches until the right front wheel touches the curb. Striking the curb with too

much force may throw the steering mechanism out of true or damage the right front tire. It is not essential that the wheel touch the curb, but do not leave the rear of the car jutting into the traffic lane. If you must accelerate to ease up to the curb, shift to low gear if you have a standard shift transmission, which will give you more sensitive control of car movement. This will prevent bumping the curb hard.

d. Set the hand brake even if the vehicle is headed slightly downgrade against the curb. Another vehicle striking it from the rear by accident might cause it to jump the curb and crash into a pedestrian or a store window if the hand brake is not set. If this should happen you might be involved in a damage suit because the law requires you to set the hand brake.

26. Parking in the Middle of the Street

a. Do not park in the middle of a street unless such parking is permitted by local ordinance or pavement markings indicate parking is permitted.

b. Park within the limits indicated by pavement markings.

27. Parking at Night

a. When parking parallel at night, get both car wheels close to the curb. State law requires parking lights on, unless other lighting on the street makes your car visible from a distance of 1,000 feet. The state law, however, enables cities to enact an ordinance to permit parking without lights.

b. A city ordinance may permit street parking without lights, but your car will be in a safer position from both collision and theft if you park it in a lighted area.

28. Illegal Parking Practices

a. Parking in an intersection or double parking in a traffic lane. These areas are needed for moving vehicles.

b. Parking on the left side of the street (except on a one-way street).

c. Parking in a fire lane. The lane may be a narrow street and extend for a block or more.

d. Parking within 15 feet of a fireplug. Firemen may have to work around the plug with fire fighting equipment.

e. Parking within the block where fire apparatus has stopped to answer a fire alarm. This area must be open for fire truck maneuvers.

f. Parking in front of a theater, hotel, or other populated building may be prohibited in some cities. Usually the restriction is posted. These areas must be kept open for fire lanes.

g. Parking within 20 feet of an intersection. This area must be left open to enable drivers approaching the intersection to see one another and to prevent congestion by providing more room for vehicles to maneuver.

h. Parking within 30 feet upon the approach to any traffic control signal or stop sign located at the side of the roadway. Drivers approaching the sign must be able to see it in time to follow its directions.

i. Parking so as to block an alley, a private driveway, or entrance to a filling station, garage, or parking lot.

j. Parking on a sidewalk or a pedestrian crosswalk.

k. Parking so as to occupy parts of two parking spaces. (City ordinance)

l. Parking within 50 feet of railroad tracks.

m. Parking in a loading zone during restricted hours for any purpose other than that of loading or unloading. (City ordinance)

n. Stopping 2 or 3 feet from the curb for that "just a minute" conversation. When you stop to let a passenger out do not start a conversation unless two wheels are within 18 inches of the curb.

o. Parking in a passenger zone or bus zone longer than is necessary to receive or discharge passengers.

p. Overtime parking. Parking limits are planned to permit more drivers to use the available parking areas. (City ordinance)

q. Some cities prohibit parking in business areas during certain hours, such as midnight to 6:00 a.m. When you stop overnight in a strange city inquire about all-night parking if you plan to leave your car on the street. This regulation permits street cleaners to clean the streets.

29. Backing Precautions

a. Before entering your car look behind it for a pedestrian, bicycle, scooter, ditch, or post.

b. Look in the rearview mirror and then look to rear, right, and left, before and while backing.

c. Sound the horn in such a way as to ask for cooperation or as a friendly warning, if pedestrians or drivers are in the area.

d. Back as if you expected to hit something but do not want to damage it.

e. When reversing direction (not at an intersection) it is harder but safer when traffic is present to back out of the roadway and pull forward into traffic instead of pulling forward out of the roadway and backing into traffic. (Midblock U-turns are prohibited in business areas in some cities.) Backing around a corner at an intersection is very hazardous anywhere if the corner is blind. Do not do it if traffic is present. Some cities may prohibit this maneuver.

f. Avoid any unnecessary backing. In areas where parking is not regulated, stop your vehicle in a position that will eliminate backing when starting. You may be more alert when you park than you will be when you start again. And you may be hemmed in unless you plan your parking for a free exit.

g. Backing fast is hazardous because neither the steering mechanism, the brakes, nor the driver is built to travel backward. A sharp cut of the front wheels may create a jackknifing effect without warning and cause you to lose complete control of your car. Fast backing can be a factor in an accident.

h. Do not back long distances down a street, because you will be driving on the wrong side even though your car is moving backwards.

i. Leaving a private driveway forward is so hazardous that the law gives the right-of-way to vehicles on the street. You can surely see how very much more hazardous it is to back out of a private driveway. Come out slowly and check frequently the positions of parked cars. If a sidewalk is present you should come to a stop before crossing the sidewalk and clear for pedestrians.

j. Most children killed by motor vehicles on private property are run down in private driveways by drivers who do not know how to back a car or truck. Skill is not enough. Before entering your car to back up, look behind it for obstructions and around the yard for children who might wander into the path of your car while you are backing. Do not hold door open while backing. Look to the rear before you start backing and while you are backing; you should sound your horn if pedestrians are likely to be near; you should back slowly, using the clutch and brake to regulate your speed to avoid backing over a child in a driveway.

k. When backing a long distance (not on a street), keep the engine pulling at a steady speed. Accelerating to a fast speed is dangerous, especially downgrade. In backing you have "front" wheel drive and "rear" wheel steering. When the "front" wheels are pulling, the "rear" steering wheels track better than when pulling traction is removed from the "front" wheels, as in coasting.

In backing it is easy to oversteer, because the positive caster in the steering wheels, which opposes oversteering in driving forward, is missing when backing.

When you apply the brakes in backing you have 60% braking on the "rear" wheels instead of on the "front" wheels, as you have in going forward. When the rear wheels are braked harder than the front wheels (like 2-wheel brakes on early cars) the rear of the car cants to one side.

Your car can easily turn over if you coast, oversteer, and brake while backing fast downgrade.

RURAL DRIVING

1. Entering a Roadway from a Shoulder (See Night Driving 5.)

a. The law permits you to enter a roadway from a parked position only when you will not endanger vehicles moving on the roadway. The law is simple and obviously sound. Drivers who have caused collisions while entering a roadway either failed to look or failed to wait after they saw vehicles approaching, either because they were irresponsible or because they could not judge speed and distance.

b. Avoid entering a two-lane road when a vehicle traveling at a normal cruising speed is approaching less than 200 feet from the front or less then 600 feet from the rear. Avoid a sharp turn entry toward the centerline. A meeting driver may think you are making a U-turn and may cross into your lane. If you enter near the approach to a bridge or within a no-passing zone, the danger is increased, because the movement of your car will create extra hazards, both real and mental, for approaching drivers. You should look upon a no-passing zone line as a physical barrier protecting drivers from unseen vehicles.

c. A left turn signal (preferably an electric signal at night) should be given prior to entering the roadway from a right shoulder if traffic is approaching near from any direction, even though the traffic may appear to be a safe distance. An approaching driver may start accelerating immediately after you look back. Stop the signal if you decide to wait.

d. If the condition of the shoulder permits, you should shift to a lower gear if you have a standard shift before you enter the roadway. You will then have power and speed control while you give your attention to traffic and steering. Accelerate quickly to normal traffic flow after entering roadway. This acceleration is very important if there is a hillcrest close behind you, especially if you enter in a no-passing zone. A fast overtaking car may be coming over the hill. The driver may not have room to avoid a rear-end collision and might cross the no-passing line instead of going onto the right shoulder. You should note whether the shoulder would be a safe escape for an overtaking vehicle. If it is unsafe, your rate of acceleration becomes even more important.

e. The last thing you should do before moving your car is to look back out of the driver's window. Checking in an inside mirror is not sufficient. An overtaking vehicle may be in the blind spot or around a bend in the road when you look in the inside mirror. Check for blind spots as well as the mirror.

f. If you move your car and then decide to wait for traffic, give a brake or hand and arm stop signal to inform other drivers that you are yielding. What drivers think you are going to do may be as important as what you do. This fact is a corollary to defensive driving and it should be a factor in all of your driving decisions involving other drivers.

2. Cruising Position on Roadway

a. On a two-lane, two-way highway:

(1) Drive in right-hand lane as nearly in the center of the lane as possible. This center position will give you small but important maneuvering room within your lane to avoid sideswipe collisions.

(2) You are permitted to drive on the left side

(a) To overtake and pass another vehicle moving in the same direction when the left side is clear of vehicles; except you must not drive on the left side when approaching within 100 feet of a bridge, viaduct, tunnel, railroad crossing, or intersection; or while passing through an intersection or across railroad tracks; or at any place where there are two yellow centerlines, or where there is one yellow line in your lane.

(b) When construction work has the right half of a roadway blocked, vehicles going in opposite directions must share the open side.

b. On a three-lane, two-way highway:

(1) Cruise in the center of the right-hand lane.

(2) Before turning off left get into the center lane. The only other time you can use the center lane is while you are overtaking and passing another vehicle, and you can overtake and pass only when the center lane ahead is visible and clear of traffic.

(3) Under no circumstances should you drive in the left outside lane, or use it for overtaking and passing.

(4) Avoid starting an overtake and pass when approaching an intersection unless you are sure that an opposing car will not enter the center lane, preparing for a left turn. The driver of the opposing car might think that you are in the center lane for a left turn also and may not hesitate to move into the center lane. The law does not require that the driver making a left turn see that the center lane is open as it does for the driver who enters the center lane to overtake and pass.

c. On a multilane (four or more lanes), two-way highway:

(1) If a four-lane road has an unpaved strip or a physical barrier between opposing traffic, it is called a divided highway. Drive in any one of the lanes on the right half of the roadway, unless posted signs instruct you to drive in a

designated lane. For example, signs may require slower traffic to keep to the right, outside lane.

(2) Ordinarily you should cruise in the inside lane if you are driving at the speed limit or faster than vehicles in the outside lane.

(3) Ordinarily you should cruise in the outside lane if you are driving under the speed limit, especially if faster traffic is present in the inside lane. If you are driving under the speed limit in the inside lane and faster traffic is present, you should either drive faster or move into the outside lane. Be sure car ahead is not stopping when you look to side to clear the lane you will enter. Do not cross the double stripe centerline or drive off the pavement in order to make a pass.

(4) Before changing lanes, signal for 300 feet, see that the lane is clear up ahead, and look to the side to be sure a vehicle is not coming up beside you in the lane you plan to enter.

d. Speed:

(1) Cruise at a constant speed. This does not mean you may not alter the rate occasionally to reduce fatigue from monotony.

(2) Alter speed to conform to the traffic pattern and to compensate for hazards. If you exceed speed limits or if you drive too slow and congest traffic, you create traffic hazards.

(3) High speeds force you to commit position violations which cause collisions. Examples of position violations are: failing to yield at intersections, passing in no-passing zones, and crossing the centerline on curves. Speed also is a factor in the severity of accidents.

3. Cruising—Following Another Vehicle

a. Normal procedures:

(1) To determine the minimum safe following distance in feet, double the mph at which you are following. This rule provides 60 feet at 30 mph and 100 feet at 50 mph. It is a safe rule only if you keep your eyes on the roadway and your mind on driving. When your attention to driving is diverted, ease off on the accelerator. As speed of traffic decreases you may drive closer to the vehicle ahead. When the speed increases you should drop back. Learn how far 60 feet and 100 feet are, check your speedometer when following, and close up or back off as the speed varies. The centerline on a rural road usually contains 15-foot dashes and 25-foot gaps. Three dashes and three gaps equal 120 feet. This guide will help you see how a car looks at different distances. After you can recognize the distance you need only to glance at the centerline occasionally. Do not stare at it while learning.

(2) Another safe following distance is the "Two Second Rule." When following another vehicle pick out a fixed object on the side of the road such as a sign, overpass, or bridge railing, then watch when the vehicle ahead of you reaches that point and count two (2) seconds. If at that time your vehicle has not yet reached the same point you have a safe following distance.

(3) On wet slick pavement you should triple your following distance. (With a little practice you can learn to recognize pavement surfaces that are slicker than others when wet.) On packed snow or icy roads quadruple your following distance. At 30 mph the distance on wet slick roads will be 90 feet and the distance on packed snow and icy roads will be 120 feet. It is folly to consider a speed over 20 mph on a road covered with sleet. According to National Safety Council tests a car going 20 mph on glare ice will skid over 200 feet.

(4) While the reaction time distance is a key factor in determining a following distance at a given speed, the distances are increased for slick roads because hard braking, safe on dry roads, will throw a car out of control on slick roads. One danger of following too close on slick pavement lies in the mental hazard which may cause you to overbrake and go into a skid, instead of braking moderately as the driver ahead may be doing. If the driver ahead should lock his wheels, the extra following distance will permit you to brake smoothly and maintain directional control.

(5) There are few driving experiences that can give a driver a more helpless feeling than to be following too close behind a vehicle that starts braking suddenly on a slick road without any warning. A driver who is following too close has already violated a defensive driving rule. He has voluntarily sacrificed his margin of safety and has let himself into that class of drivers who cannot cope with the complex problems of modern traffic and who have to depend upon defensive drivers to keep them out of trouble. When other drivers cannot or simply do not protect him he gets into a collision. He does not recognize that other drivers may have been helping him. He may be so deceived in this that after a rear-end collision he will continue to think that he has been doing a good job of driving and that the driver ahead did something wrong and trapped him. The driver ahead may have done something wrong in failing to drive defensively to compensate for the error of the driver behind, but the driver behind can do more than the driver in front, who may be forced to make a sudden stop to avoid a hazard that appears suddenly. The driver behind,

when too close to a vehicle ahead, is committing a continuing error and one which he has plenty of time to correct. Even if the driver ahead fails to drive defensively the driver behind cannot stand on his error and shift all of the blame to another nondefensive driver. A driver who follows too close has himself set the trap he will complain about after a collision. He rides in his own trap. A collision occurs when someone or something triggers the trap.

An instructor has two main jobs in teaching procedures in following. One is to convince his student that following too close is a hazardous practice and the other is to see that the student recognizes proper following distances in feet at various speeds on dry and slick roads.

b. Factors in determining when to increase the following distance:

(1) Attention to the job of driving. If you are tired or mentally distracted, increase the distance.

(2) The reaction time of the driver. If your reaction is slow or you are physically handicapped, including poor eyesight or weak leg muscles, increase the distance.

(3) The braking distance of your vehicle. If your brakes are weak or the road is slick, increase the distance.

(4) The following distance of the vehicle ahead. If that vehicle is following too close and hits the vehicle ahead of it, the vehicle ahead of you will skid a shorter distance. The distance in which you can brake before hitting the car will be less.

(5) Headlight glare recovery time. If your eyes are slow to recover from headlight glare, increase the distance, because the driver ahead may brake suddenly during the few seconds it takes your eyes to readjust.

(6) Possible actions of driver ahead on a curve or at an intersection. If the driver crosses the line or makes a sudden change in direction, he may force other vehicles into your path. If it appears likely such a hazard might develop, you should increase the following distance as the vehicle ahead approaches the point of the potential hazard.

(7) Visibility. Increase the distance at night, in fog, in rain, and in dust or smoke.

c. You will reduce the possibility of being knocked into a vehicle ahead if you allow an extra "cushioning" distance in front of your vehicle when you see a car is following too close behind you. You only increase the danger when you follow closer in order to get away from a car behind you.

This "cushion" precaution is important also when stopping at a stop light or stop sign. By signaling early a driver following too close is warned earlier; then by stopping about one car length behind the vehicle ahead, you will have a safety "cushion" to prevent your being knocked into the vehicle ahead in case the driver following you skids into your car. You may need the room to move up after he starts skidding. After he stops you may ease up a few feet. A truck following you too close is more dangerous than a car. In normal braking, with wheels rolling, a truck requires more stopping distance than a car. If at 55 mph you would require 230 feet, a loaded three-axle truck behind you going 55 mph might require 390 feet. For this reason a truck should follow a car at a farther distance than a car needs to follow a truck. Doubling the mph is not enough for a truck.

d. When the driver ahead of you starts to overtake and pass another vehicle, avoid pulling up into the position he left. He may have to get back in line and you may cause him to be involved in a rear-end collision either with the car ahead of him or with your own vehicle. Be certain that he is going to complete his overtake and pass before you move up into the position he left.

e. When you are following within 300 feet of another vehicle at night, common courtesy as well as Texas traffic law demands that you keep your headlights on the low beam to prevent "blinding" the driver of the vehicle immediately in front. At a normal following distance you will be able to see well enough to drive on low beam. Your low beam will light your way to the vehicle ahead and the beam of the vehicle ahead will light the shoulder beyond. You should, however, give your attention to the roadway so that there will be no seeing lag should it be necessary for you to slow down quickly.

f. There are few driving procedures more difficult for a driver to learn and practice than a safe following distance. Driving too close is a trap from which a driver cannot escape once the trap is sprung. To avoid the trap a driver must know distances and he must watch his speedometer. Then he must be convinced that he is always in danger when he is following too close. Only then will he develop a self-discipline that will make him back off as his speed increases. A driver going 50 mph following 50 feet behind another car is exposing two cars and all passengers to damage and injury. All that he can gain is to get to his destination 50 feet earlier than he would if he were following at 100 feet. At 50 mph this gain amounts to approximately seven-tenths of one second.

g. If a vehicle is following you too close, you are still in danger. You can shake the vehicle by slowing down when you reach a good place for it to pass.

h. Another reason for following at a safe distance is that a driver overtaking and passing should have ample room to move in ahead of your car. When you are following too close,

a driver overtaking and passing you will have to overtake and pass two vehicles at one time. It is to your advantage to leave an opening for him to get back on the right side. If you follow too close and squeeze him out, he may involve your car in a three-car collision.

i. Any time you see that another driver must have more room to escape from a trap, you will be wise to give him the needed room if you can. You will be wiser still to anticipate the room he will need and give it to him early. You can prevent many traps from developing if you will look for the opportunity. You are headed for trouble if you crowd a driver in order "to teach him a lesson."

j. When you follow the two-second rule you must keep your eyes peeled for a stop light warning in case the driver must make an emergency stop to avoid a hazard which you may not see. If you lock your brakes within one second after the driver locks his, your car will come to a stop 18 feet behind his car (that is, if your car does not skid across the centerline into opposing traffic). It is easy to understand that if you are looking at the scenery, lighting a cigarette, or otherwise distracted for even one more second you could collide with the car ahead (your car travels approximately 73 feet per second at 50 mph).

k. If you are a Sunday driver, that is, one who seldom drives on rural highways, you may be prone to follow a vehicle going 50 mph at the distance in which you are in the habit of following a vehicle going 30 mph. Using the two-second rule will compensate for this.

4. Cruising—Miscellaneous Problems

a. Vehicle which is standing still:

(1) School bus that is stopped inside or outside of a business or residential area and is receiving or discharging students:

(a) When there are flashing red lights displayed on the school bus, and you are approaching from either direction (from rear only on a divided highway) you must come to a complete stop.

(b) You are required by law to remain stopped and not proceed until (1) the bus resumes motion or (2) the bus driver signals you to do so or (3) the flashing red lights are no longer actuated. You should approach school buses in an urban area with the same precautions. Even though your speed will be less the danger is great.

(c) The greatest danger in approaching a school bus is from vehicles behind you. Give a hand and arm signal and flash your stop light the instant you see that a school bus ahead is going to stop.

(d) A school bus carrying any school child or a motor bus carrying passengers for hire must stop at railroad crossings unless a signal or an officer directs traffic to proceed. You may pass these vehicles while they are stopped provided you do not drive on the left side of the roadway in making a pass. On four-lane roads there is no problem of congestion, but on a two-lane road bus drivers should pull far to the right side of the right lane to make these stops. This courtesy may enable other vehicles to go by them without crossing the center stripe.

(2) Other vehicles parked by the side of the highway:

(a) Check your mirror and look ahead to determine whether your car and other cars will arrive at the parked vehicle at the same time. If they will, alter your speed to avoid this timing. If you cannot avoid it, slow down and tap your horn to warn the driver of the stopped vehicle who may be ready to start or to warn pedestrians who may walk onto the road. Expect a car door to open suddenly. If the stopped vehicle is parked partly on the pavement you should take the same precautions as for a pass because you will have to drive on the left side. If a meeting vehicle is coming you must yield the right-of-way to it even if you have to stop.

b. Pedestrians:

(1) Slow down if pedestrians are on or near the roadway. Prepare for an emergency stop. You should expect any child nearby to enter the roadway. Flash stop light to alert drivers for an emergency stop.

(2) Use the horn only when necessary, and then use repeated short blasts. When you need the horn as a warning, use it early. Be especially wary of a pedestrian with his back to you. Sound is deceptive and a pedestrian may assume the sound of your horn is coming from another vehicle which he sees in the opposite direction. When meeting a driver who is approaching a pedestrian, a parked car, or livestock on his side of the highway, give way to the right and reduce speed to a rate at which it will be safe to leave the pavement in an emergency. Glance at the shoulder to see whether it will provide a safe escape. If it will not, your only recourse is to prepare to stop in an emergency.

(3) If you meet a vehicle which is about to pass a pedestrian who is on the far shoulder, you should give way to the right side of your lane to reduce the mental hazard for the other driver who may become confused if the opening between the pedestrian and your car is narrow.

(4) Do not plan an overtake and pass which will pen the car ahead between your car and a pedestrian who is close to the pavement. And always sound your horn before overtaking and passing a vehicle where a pedestrian is up ahead.

c. Livestock:

(1) The law prohibits unattended livestock on U.S. and state highways. On other roads, including farm-to-market roads, the regulation of livestock is left to local option by county.

(2) The best procedure is to lower your cruising speed on unfenced highways and in localities where livestock are known to be at large. This is the only thing to do at night or in hilly country where you may expect to find livestock or wildlife in the middle of the road just over the next hillcrest. In many of these localities, signs have been erected to warn motorists.

(3) When it appears you will meet a vehicle near livestock, alter your speed to avoid a trap in case either the vehicle or the livestock start dodging the other and catch you in the middle.

(4) Animals standing or walking slowly on the shoulder near the pavement may dart into the path of your car if they are startled. Avoid using your horn unless your speed is very low. You may expect a pig to run fast across your lane, then turn around at the center stripe and start back. In a low foggy place, you may expect to find a cow standing on the pavement chewing her cud. Always go into a fog slow and come out whole.

d. School, church and hospital zones:

(1) Slow down and be on the lookout for pedestrians and for vehicles entering the highway from side roads or from the shoulder. Check your mirror for vehicles that may be close behind.

(2) You should never make any unnecessary noise in any of these zones. Use your brake before using your horn.

e. Areas where people are working on or adjacent to the roadway:

(1) These areas are usually marked by portable signs, but drivers have hit highway workers and then claimed they did not see the sign or "the sign was way back yonder."

(2) The closer you come to pedestrians the more you should reduce your speed. You may need to slow to 10 mph or less in some situations. As you approach parked trucks or road machinery expect a worker to step down into your path. You should always check your speedometer to get your speed down to a safe approach. Ignore your feeling. Rely on your speedometer. Driving fast by workers is a reckless and discourteous act; they cannot work and watch traffic. They are there to repair the roads you drive on. It is the driver's job to do the watching. The main responsibility lies with the driver.

(3) Be alert for a construction flagman and comply strictly with his directions.

f. Being passed on a two-lane road:

(1) If you are driving under the speed limit and cars pass you frequently, check your rearview mirror every 5 seconds so that you will know when a vehicle is preparing to overtake and pass your car, even if the driver does not signal. This precaution will enable you to avoid a trap caused by some hazard ahead of you which the overtaking driver cannot see. The hazard may be a small animal on the right shoulder or a vehicle entering the highway from a side road. Keep to the center of your lane so that a driver behind you can see down the left lane without riding or crossing the center line.

(2) Drive to the right side of your lane while a vehicle is overtaking and passing you and do not increase your speed. You are required by law to do this when the overtaking driver sounds his horn to overtake and pass you on the left side of a two-lane road. Do it anyway whenever you think it will make a pass safer. It takes cooperation to overtake and pass safely.

(3) If the overtaking driver decides not to pass and tries to get back onto the right side behind you, increase your speed to give him room. Be sure he has given up the pass. Otherwise, increasing your speed would be illegal. Your privilege to drive under the speed limit places a responsibility upon you to aid another driver who wants to drive at the speed limit. In passing he is overcoming the obstruction you create.

(4) If the overtaking driver completes the pass and has to cut back to the right side to escape a meeting vehicle, decrease your speed and pull to the right, even off the pavement if necessary, to give him room. If you fail to do this early enough, the overtaking driver may sideswipe your car or the meeting driver may decide to cut across your lane in front of you to miss the overtaking vehicle. It is important that you act early to take the pressure off the other drivers, either one of whom may panic and involve you in a fatal accident. Your responsibility to remove your car as an obstruction continues throughout the pass.

(5) Alter your speed up or down to avoid being involved in a pass in a no-passing zone or other hazardous areas, or to

avoid delaying other drivers in such areas. Each of us should make a sincere effort to share the road, because no one can drive very far without infringing on other people's territory or relying on their courtesy.

g. Meeting a vehicle overtaking and passing in your lane:

(1) Excerpt from a report of a fatal accident in which a mother and twin daughters were killed: "He was on the wrong side of the road, and she turned to the left instead of the right to get out of his way." The instant you see that a driver overtaking and passing in your lane may be trapped, you should slow down and drive to the right of your lane. (Slowing from 60 mph to 50 mph takes 60 to 70 feet off your braking distance.) Glance to the right shoulder to see whether it will be safe to hit the dirt. If it becomes necessary and there is no vehicle or fixed object in the way, go onto the shoulder. If the shoulder is obstructed, make an emergency stop in your lane. **The important thing is to take these precautions early, before you are trapped.** If you slow down early, the hazard of hitting the dirt will be reduced in case you have to leave the pavement. If you leave the pavement early you relieve the pressure on the other driver who, otherwise, may panic and meet you on the shoulder. Going to the right shoulder early may eliminate any need to try to escape to the left.

(2) When you drive onto the shoulder, ease on the brakes and steer straight along the shoulder or bar ditch until your car is under control. You can do this at 40 or 50 mph without damage, if you do not panic. The longer you wait to take defensive action the more likely you are to panic when you do act. Many a stubborn ghost who waited three seconds too long will nod to that statement.

h. Meeting and overtaking funeral procession:

(1) Drivers in commercial convoys (two or more motor vehicles drawing other vehicles), caravans, or motorcades outside of cities, must leave space between units or vehicles for overtaking vehicles to enter and occupy safely. This law does not apply to funeral processions. You should not therefore, expect to find space for overtaking and passing between vehicles in a procession. If you attempt to overtake and pass a long procession at one time, you may drive into a trap. The best procedure is to follow a procession until it turns off the highway.

(2) In meeting a procession on a two-lane road you can best display a courteous respect to the dead by parking on the shoulder and removing your hat (male drivers). Usually the vehicles in a procession will have headlights burning. You should have time to identify a procession and select a safe and legal place to park before you get to the procession. It is possible that the condition of a shoulder and/or the volume of traffic would make this courtesy unsafe. If so, slow down and uncover.

i. Meeting vehicles on a narrow bridge:

(1) When you meet a driver on a narrow bridge and he slows down noticeably, you should suspect either that he is confronted with a mental hazard created by the apparent narrowness of his lane (near your car) or that he has defective vision. You will be wise to slow down to the rate of speed at which he is driving. This precaution may prevent his sideswiping your car.

(2) An added danger in wet weather in failing to slow down when meeting this slow driver lies in the fact that your speed may cause him to apply his brakes too hard and skid into the path of your car. Approach this slow driver on a bridge as you would approach a nervous horse, gentle like.

j. Hazards you cannot see may indicate their presence; diesel smoke ahead beyond a rise in the roadway; fresh road marks of a farm tractor that lead over a hill ahead of you; a shower ahead on an oily roadway; erratic motion of vehicles ahead caused by wind gusts; smoke ahead on the upwind side of the highway; fog conditions along an undulating roadway; whirlwind ahead approaching the highway; cloudburst in area ahead that could suddenly flood low water crossings; a bridge ahead when the temperature is low; vehicles you are meeting slinging mud; borrow ditches full of water which might cover low roadway ahead; school bus travel hours during school days; sun behind you and near horizon; hilly roadway not marked with no-passing lines.

5. Cruising—Driving on Curves

a. There is a point somewhere between the front and rear wheels and between the ground and the top of the car, called the center of gravity. If a car were suspended by a wire at this point, the car would be in balance, no matter how it might be turned, much as a pencil that is balanced on a finger. The car is designed to locate the c/g as close to the ground as is feasible and fairly equidistant from the four control points. When six passengers enter a car its c/g moves aft and up. A boat on top of a car moves the c/g higher still. A heavy load in the trunk compartment moves it farther back. When the c/g is shifted the driver must alter his control habits. The higher the c/g the easier it becomes to turn the car over. The farther back the c/g moves the more difficult it becomes to maintain directional control. It is much like trying to carry an axe level and straight by holding the handle in the middle. The control point is too far from the c/g of the axe.

b. Inertia tries to keep a moving object going in a straight path. The instant you turn a car from a straight path, a force

begins to act from the inside of the turn to put the car back on the straight path. In a nutshell, a car does not like turns and the faster it is moving the more it dislikes turns. Many fatal accidents in Texas occur when drivers are trying to turn their cars. The cars do not hit anything. They simply overturn or run off the roadway when novice drivers try to turn them too sharply. At low speeds a turn may be made abruptly. As speed increases a turn must be more gentle. If the pavement is wet, water between the tires and the road reduce the driver's control forces. A turn that would give no trouble on dry pavement could start a severe skid on a slick road. Centrifugal force is the term applied to the side push, which really is inertia trying to pull the car back into a straight path. On a curve the straight path leads to a tree or a fence or down the opposite lane into meeting vehicles, depending upon which direction a turn is made. The turn does not have to be on a curve. It can be on a straight road, as when a driver cuts back after a pass. It's all the same to inertia, forward or backward, but a curve is the problem here and a curve serves to illustrate how treacherous inertia is.

c. When the CF exceeds the product of the weight (of the car) times the coefficient of friction (the grip of the tires on the road) the vehicle will slide off a flat curve. If the driver steers inward to keep it on the road it may spin and overturn. The higher the c/g is the more easily it will overturn. The driver has controls in the gas pedal and steering wheel to keep inertia fr[illegible] taking over control of his car, but once inertia takes over, there is no return. The transfer of control takes place in a split second. No transfer papers are signed. There is no time to barter. The only chance a driver has is to avoid inertia's invisible trap. On a given curve the amount of turning is fixed. You can escape the trap only by reducing speed. CF makes a car tilt and you can "feel" its push against your body. A small reduction in speed helps a lot because CF decreases as the square of the speed, in the same way that it increases.

d. The Society of Automotive Engineers describes a racing car skid in a turn at a high speed: The inside rear wheel is the first to slide. This puts extra force on the other rear tire. If the tire breaks away, the car spins, unless reverse steering is applied rapidly. To reduce the hazard, the inside rear tire should have the highest possible load.

This study indicates that the distribution of load on the rear wheels might make a turn on a sharp curve in one direction more hazardous than a turn in the other direction. If passenger and trunk load is much heavier on the left rear tire than on the right rear tire, you might at a given speed on a given curve, hold to the road when turning left, yet skid when turning right coming from the opposite direction.

e. Slow down **before,** not after entering the curve. It takes willpower to do this, because the need to slow down will not seem urgent. If you wait until it does seem urgent you are already in trouble. The engine should be pulling, not accelerating, as you drive around the curve. This pulling force aids directional control, provided you are in the curve at a safe speed.

f. If you are in a curve too fast and you hit the brakes too hard you may throw your car into a side skid. Just before entering a curve too fast but while still going straight you might bring a car under control within a short distance by a few quick, successive applications of the brakes. This method of braking will reduce the centrifugal force which will hit your car shortly, and will reduce the chances of overbraking, which may cause your car to skid. Overbraking causes a skid which causes a panic which causes more overbraking. Avoid this trap by avoiding overbraking in the first instance. Avoid overbraking by braking early.

g. When you release the gas pedal in a curve, the drive force (centripetal force) "accelerating" the car toward the center of the curve is diminished. The centrifugal force becomes more nearly equal to the centripetal force. If the centrifugal force is such that the tire traction is barely holding the car in the curve, hard braking might start a skid. Letting off on the gas pedal produces a slight "braking effect," because it eliminates the drive force. However, when the brakes are applied, a force opposite to the drive force is exerted and the ball in a bank indicator will slew outward, indicating a relative increase of centrifugal force. If an instructor will equip his Driver Education car with a ball-bank indicator, he will be able to demonstrate this change visually.

h. An instructor should demonstrate on a dry road that a car can be braked in a curve without losing co[illegible]. A student should learn to respect a curve, not fear it. He should understand that the same amount of braking effort as applied in the demonstration could cause a skid at the same speed on wet pavement or at a higher speed on dry pavement. In order to condition a student against panic the instructor must show him what a car can do, if handled properly, in an emergency. If an instructor merely quotes rules such as "don't use brakes in a curve" his student may sometime delay using brakes until he panics and then involuntarily overbrake and turn over. During training a student should be graded down for approaching a curve too fast. Once he approaches a curve too fast and fails to ease off on the accelerator, or fails to use the brakes properly if they are needed and can be used safely, he should be graded down again. If a good shoulder is present and he could use it safely in conjunction with overbraking and does not, he should be graded down a third time.

i. No matter how much centrifugal force is acting against a car in a curve, it all disappears the instant the driver turns the front wheels to let the car move in a straight line, tangent to the curve. If, therefore, a driver, going too fast in a curve, will straighten the front wheels for an instant and hit the brakes quickly for an instant while straight, he may reduce his speed

enough to continue in the curve safely. Severe braking in a curve is dangerous when CF has a vehicle near the point of skid. If the longitudinal axis of the car points inside the tangent of the curve, either the drive force of the rear wheels (or gravity, if downgrade) is keeping it there. When you brake, the drive force is reduced. If the front brakes grab ahead of the rear brakes, you give CF aid in an impending skid.

j. Advisory signs designating safe speeds for driving around curves have been erected on approaches to many curves. The numbers on these signs are not speed limits; the numbers inform drivers the prudent speed at which a vehicle may be driven comfortably and safely around the curve on the right side of the center stripe. On wet, muddy pavements these advisory speeds may be too high for safety. It should be obvious that they are not reliable when a curve is coated with snow or sleet. These signs are not erected to challenge your skill. They are advance guides to enable you to keep to the right of the centerline without building up too much centrifugal force.

k. When you drive around a curve to the right, the left side of your car goes faster than the right side so the left wheels have to turn faster to keep up with the right wheels. On a curve to the left the situation is reversed. Except with front-wheel drive vehicles, the front wheels are not connected, but the rear wheels are connected to the drive shaft. The differential permits both wheels to drive yet turn at different speeds. Without the differential the rear end of a car would have to side hop around turns.

The differential, however, increases the danger of skidding. On a straight road when one rear wheel hits a slick place, the differential lets that wheel turn faster than the other rear wheel which keeps gripping the ground and driving. (On a curve both wheels normally are gripping even though they turn at different speeds.) When both wheels are driving on a straight road and one suddenly starts slipping, the other one tends to drift over to a position between the front wheels. This movement initiates a skid. If the car is on a curve with CF pushing on its side, you can see that hitting a slick place on a curve may be more hazardous than on a straight road, especially if the outside wheel slips. The slick place may be an oil spot. It may be traffic film on one side of the lane. Or it may be a wet pavement where one side of the traffic lane is rough and the other side is traffic polished, with a film of water over it. Ordinarily you should ease up on the gas pedal just before hitting a slick place in order to reduce the chances of spinning one wheel. On a curve you should ease up on the gas pedal earlier for another reason to prevent CF from being higher than the grip of your tires on the pavement. Maintain a constant speed in a curve.

l. There is a skid trap on a wet pavement curve which has a slight dogleg bend at the dead point of an otherwise uniform curvature. An abrupt movement of the front wheels at this bend may start a skid, especially if the pavement is traffic polished and is covered with a film of water.

A much worse skid trap is a pavement with traffic film (oily) on which a light shower has just fallen. If you are on such a road and an informational speed sign at a curve reads 45 mph, you had better enter the curve at about 30 mph.

m. A defensive driver must learn to recognize road areas ahead where his rear wheels will have less traction or where one rear wheel will have less traction than the other. He must then relate a traction hazard he sees to other traffic. If the traction hazard is in a curve he must also consider the elevation of the curve and whether it is right or left, for both his car and a meeting vehicle. He must consider the speed and weight of opposing vehicles if the traction hazard extends into the other lanes. After a defensive driver considers all of these factors, he must adjust the speed and position of his car to avoid a trap. The ability to recognize a trap requires knowledge. The ability to use the knowledge to make proper decisions is good driver judgment. The ability to coordinate the controls to execute good judgment is skill.

n. A gyroscopic effect of the turning wheels causes the rear end of a car to tend to slew outward when a car goes into a banked curve and to tend to slew in the opposite direction when the car returns to level pavement. This effect is not a problem if the banking is long and gradual. Occasionally you will run into a short vertical curve in which both the climb and the bank are abrupt. You might even be tempted to speed up for the thrill the quick change of the car's attitude will give you. If you enter a short banked climbing turn to the left, say, the gyroscopic force will slew the rear wheels outward in the direction CF is pushing. If a skid starts, you will cut the front wheels to the right to recover. By the time you do this, the car is back on a level tangent and your turning to the right will aggravate the slewing of the rear wheels to the left. You may find yourself suddenly off on the right shoulder. This will surprise you. You may over-control to return to the pavement and run into an opposing vehicle, or you may overturn trying to straighten up.

The gyroscopic effect of the flywheel also may influence directional control of a car in curves and in passes.

o. Next to entering a curve too fast, comes the hazardous error of cutting across the center stripe. Usually this error results from too much speed, but there are many drivers who drive at safe speeds on curves yet apparently are unaware of the importance of staying right of the centerline. It is safer to straddle the center line on a straight road than on a curve, because centrifugal force is not present on a straight road. If you form a habit of this error when "no one is coming," the habit will lead you into a trap, because the practice will develope a second habit of entering curves too fast to drive safely back to the right side of the centerline when you meet a vehicle in a blind curve. When meeting vehicles on a curve, check the shoulder and be ready to leave the pavement

should a driver cross the centerline. On gentle curves in four-lane roads you may change lanes providing you signal and do not interfere with other traffic as you cross a lane line. However, avoid changing lanes toward the center of a curve on a slick road. This maneuver may increase the CF sufficiently to start a skid.

p. The physical forces acting on a car in motion create a treacherous trap which help us understand why 22% to 25% of the rural fatal accidents in Texas involve a car simply running off the roadway.

A driver goes into a curve too fast. He hits his brakes too hard, loses directional control of the car and starts skidding off the curve. He panics—that is, he is unable to relax his muscles for a second or two in order to get off the brakes. In two seconds his car is smashed against a tree or is rolling over a fence. If he lives, he may say something went wrong with his steering gear. He turned the wheel, but his car wouldn't turn. This tale and similar ones just as pitiful are repeated by the dozen month after month, year after year, by otherwise intelligent drivers who are unaware of forces developed by a moving car or who do not understand how the forces increase with speed or accumulate against a driver.

q. A driver on a curve meeting traffic has three places among which to divide his attention:

(1) First, he should look down the center of his lane in order to keep his car properly positioned in the middle of his lane. Actually, he will be looking at points on the center stripe down the center of his lane as he goes around the curve. If he is driving at a safe speed the dashes in the centerline will appear to be barely moving at the place his vision meets the center stripe. If the dashes appear to be moving briskly, he may be driving too fast. The center of his lane is the place he should be looking most of the time. He only glances at two other points on the road. He never takes his eyes off the curve.

(2) Second, he should look at the ground near the front wheels of vehicles as they approach within 200 feet of his car, in order to see whether the vehicles are headed toward the centerline. He does not have to look at a vehicle or its occupants. If he takes his eyes off the ground very long his car may wander from the middle of his lane. This check of the ground near the other vehicle's front wheels will let him know the direction the vehicle is headed, and if it is cutting toward the centerline he may have time to yield or sound his horn to alert the other driver.

(3) Third, he should look across the curve toward its end to detect developing hazards which he must know about in time to take defensive action. Here again he can look at the ground and see vehicles, animals, pedestrians, etc., if they are present. The point is that he should not gaze at a moving vehicle or an animal. He may look at it too long and let his car wander from the center of his lane.

r. Lower your headlight beam early when you enter a right curve at night, because the high beam across the opposite lane is especially hazardous to opposing traffic.

s. Excerpts from a newspaper account of a Texas fatal accident which occurred on a curve:

"A pickup truck and a crowded old model sedan collided north of this East Texas town early Monday killing 10 persons, five of them children. Nine of the dead were in the sedan and the tenth victim was the driver of the pickup truck.....The wreck happened on a curve eight miles north of...."

6. Cruising—Driving on Hills

a. If a road curves up or down a hill, it is said to make a vertical curve. Many drivers have lost control of their cars by going up a vertical curve too fast. Going down a vertical curve is even more dangerous because gravity and CF are working together.

b. Slow down before reaching the crest of a hill and hold well to the right just as you would upon entering a blind curve. Speed should be reduced near the crest of a hill to that rate which will enable you to bring your car to a stop within the clear distance you can see ahead. The sharper the hillcrest, the more you will have to slow down, as you would on a sharp curve.

c. In approaching the crest of a hill, consider the possibility that someone may be parked on the pavement just beyond the crest of the hill, or that another car going too fast over the hillcrest may have had a wreck, blocking the road just beyond the crest of the hill. Decelerate this side of the hillcrest. Reducing speed 5 to 10 mph may decrease your braking distance enough to prevent a collision. When you reduce your speed from 50 mph to 40 mph you decrease your skid distance 50 feet (based on a coefficient of friction of .6). If at 40 mph you locked your brakes and skidded 89 feet and stopped bumper to bumper with a car parked in the roadway, at a speed of 50 mph you would have 50 feet more to go when you hit the car.

d. In approaching a hillcrest you may be meeting someone who is carelessly attempting to pass another car on the other side of the crest of the hill. You must be ready to leave the pavement. Check the right shoulder as you approach the hillcrest to see how fast you could drive onto it. A defensive driver must condition himself mentally for such emergencies, like deciding whether a chance of turning over in a borrow

ditch is safer than hitting head-on at the speed he is going. A driver may prefer the borrow ditch at rural speeds, but he would never reach it if he should lock his brakes before changing the direction of his car.

e. On hilly, winding roads sound the horn before reaching a bend or a hillcrest. This warning will give a meeting driver on your side of the road time to get out of your lane. He may not have time after he can see your car.

f. When starting from a stop on an upgrade:

(1) Set the hand brake.

(2) Shift to low gear.

(3) Accelerate the engine in proportion to the steepness of the grade.

(4) With standard transmission let the clutch pedal out to the point where it begins to slow down the engine. Keep the engine pulling.

(5) Release the hand brake gradually and at the same time increase gas and let the clutch pedal out gradually until the car begins to move forward smoothly. The foot brake may be used with an automatic transmission.

g. When approaching a hillcrest at night and the glow of meeting headlights indicates you will meet a vehicle on, or near, the hillcrest, you should lower your headlight beam and reduce speed enough to make the low beam safe.

h. Do not rely on brakes down a steep hill. Long application of brakes wears out bands fast and the high heat generated may warp the brake drums. But the immediate danger is a brake fade from overheating. In prolonged use of brakes an alternate application and release of the brakes will delay overheating. Shift to a lower gear before starting down a steep hill. If it is necessary to shift to a lower gear while going down hill and you are going too fast to make a direct shift easily, you may double clutch:

(1) Depress clutch pedal.

(2) Place gear in neutral.

(3) Let out clutch pedal.

(4) Rev engine to speed of lower gear.

(5) Depress clutch pedal.

(6) Ease lever into lower gear.

(7) Ease out clutch pedal.

i. If you are about to stall in second gear going up a steep grade, you can shift gears directly from second to low gear. The car should be **almost stopped** and the engine **almost stalled** to make the shift. The shift must be quick.

j. When holding a car on a slight grade, as at a signal light or stop sign, use the foot brake instead of the clutch and accelerator. The latter method causes abnormal wear of the clutch and lets your car roll. If the grade is steep set the hand brake, so your car will not roll back when you start again.

k. The braking distance decreases on an upgrade and increases on a downgrade. A driver must allow more distance for stopping on a downgrade:

(1) A car with 60% braking effort on a road surface that has a coefficient of friction value of at least .60 can be stopped on a level grade at 30 mph in 50 feet; at 50 mph in 139 feet. On a 10% downgrade at 30 mph the distance will increase to 60 feet and at 50 mph to 167 feet.

(2) Some roads have friction values much less than .60. The lower the friction value, the longer the braking distance will be. Furthermore, the above figures are for locked wheel stops, which would be very dangerous on a steep downgrade at 50 mph. Nonskid stopping from 50 mph on a 10% downgrade could easily require 200 feet. The kinetic energy of 50 mph virtually increases your 18-foot car to a length of 200 feet.

l. The force of gravity changes its angle of pull on a car when the car is traveling uphill or downhill. This change alters the effects of a driver's normal coordination of steering, accelerating, and braking, even when the driver is alone. An overload or a poorly distributed load (which shifts the normal center of gravity) plus centrifugal force when the car enters a downhill curve may so alter the directions and magnitudes of forces acting on a car that the driver cannot maintain directional control. A good example is a man who ordinarily drives alone on level roads. He overloads his car with family and vacation paraphernalia and heads for the mountains. This driver is ripe for a rampage down a ravine.

7. Rural Intersection Problems

a. A defensive driver gives careful attention to all crossroads and side roads before he is near them. The nearer a driver is to an intersection the longer the time required to clear in each direction, because he must move his head through a greater arc in order to see right and left. Usually highway signs will warn a driver early that he is approaching a side road difficult to detect. When you see a side road sign, you should first check traffic meeting you for indications that a vehicle may

be preparing to turn left in front of you onto the side road. If a vehicle is slowing down or moving over onto or across the centerline or the driver looks mainly to his left, you should brake or at least get your foot on the brake pedal ready for a quick stop. You should also note whether a second vehicle is following the first one. If not, you will have an escape to your left should the driver suddenly turn left in front of you. If there is a second vehicle you will be trapped unless it goes onto the shoulder.

b. If a car is approaching your highway from a side road, you should assume that the car will enter the highway without stopping. You prepare by checking fore and aft for other vehicles and their speeds, by noting condition of shoulders, by easing foot onto brake pedal and thumb onto horn ring. When a driver on a side road reduces his speed gradually he indicates to drivers on the main highway that he sees them and intends to yield the right-of-way. A hand and arm signal also will aid to inform drivers on his left. Approaching a main highway at fast speed and slamming on the brakes to stop just short of the pavement is about as funny as pulling chairs from under people who are in the act of sitting down.

c. If your view down a side road or crossroad is obstructed, you should immediately switch to a decelerating approach. The blinder the intersection is, the more you decelerate. You should assume a car will enter the highway from the side road until you are close enough to the intersection to see that one will not. When two cars are approaching a blind intersection at the same time and one driver fails to do this a collision results. If you relax the accelerator early the engine may slow your car down sufficiently. While the engine is decelerating the car hold your foot over the brake pedal ready to apply brakes. If you have to brake quickly this procedure will reduce your reaction time distance. Blind intersections without signs or signals double the loss of time to the driving public, because drivers cannot tell whether other vehicles are approaching and one cannot indicate to another his intention to yield. Consequently, all drivers have to slow down to enter the blind intersection safely.

d. If stop signs are posted at the entrances to a protected highway, drivers approaching this highway are required by law to stop before entering; if they do stop, the drivers on the protected highway can safely proceed through the intersection.

e. A driver on a crossroad approaching a stop sign at an intersection should stop at the stop sign or a stop line if one is painted on the pavement. If his view of traffic is obstructed at either point, he should ease out and stop again. However, if there is not a stop sign, yet there is a vehicle approaching close on the main highway, the driver should stop anyway as a defensive procedure. Common sense and common courtesy dictate this procedure. The driver should make this stop at least 15 feet from the pavement so that he will not create a mental hazard for the driver on the main highway.

f. When you are on a "through" highway, approaching a crossover or a side road, and you see a car approaching from the side at such a distance and at such a rate of speed that both cars are likely to reach the intersection at about the same time, you should prepare to yield in case the other driver does not. While a driver on your left should yield the right-of-way even if no stop sign faces him, you must face the fact that one driver must yield to prevent a collision. When you consider further that you have more control over yourself than you do over the other driver, the procedure you should follow becomes clear. Focus your attention on preventing two vehicles from crashing rather than on how the other driver should favor you. Your job is to keep other vehicles away from your fenders, rather than to joust with other drivers.

g. Should it be necessary at any intersection to slow down under a speed of 15 mph, it is a good practice to shift into second gear and remain in second gear until you pass through the intersection unless, of course, it is necessary to stop before passing through the intersection. Second gear gives the driver the power which high gear does not provide. Second gear also makes for faster stopping if a quick stop is required.

h. Local drivers frequently turn left into side roads or into private lanes for which there are no signs on the highway. These left turns are especially hazardous when they are made within no-passing zones, because drivers meeting the vehicles turning left may think it is illegal to turn off across a no-passing zone line. The State Department of Highways and Public Transportation has construed that the no-passing restriction is against driving in the left-hand lane and not against crossing the left-hand lane to leave the highway. You should, therefore, look for lanes or side roads within a no-passing zone and be alert for a vehicle which might pull out of a line of meeting traffic and cut across your lane. If you are planning such a left turn, always give a signal for at least 300 feet to alert meeting drivers who may not expect you to turn. They may not see your directional turning light which may necessitate hand and arm signals. This left turn is illegal if it will interfere with meeting traffic.

8. Turning from Main-Traveled Highways onto Side Roads

a. Two-lane highways:

(1) If you are traveling 50 mph, start slowing down gradually about 500 feet from the intersection. Give a slow

signal if a vehicle is following too close. Don't let your feeling that you are slowing down too early fool you.

(2) Give the proper hand and arm or electrical turn signal continuously during at least the last 300 feet before entering the intersection. (The law requires a signal for 100 feet, but this is not enough on a fast rural highway.) If you turn left off a highway where there is not an intersection, your turn may surprise or confuse other drivers who might otherwise expect a turn at a side road which a road sign informs them is ahead. You can emphasize your intention to turn by giving a directional turn signal, a hand and arm slow signal, and by flashing your stop light.

(3) On approaching for a right turn, keep to the right-hand side of your lane near the shoulder. On a busy highway, if the shoulder permits, you may ease off onto the right-hand shoulder before you reach the intersection. If you do this at only 15 mph, congestion which you might cause by staying on the pavement will be prevented.

(4) In making a left turn where traffic speeds are low (under 40 mph) or traffic is light, drive just to the right of the center stripe until you enter the intersection. This is the normal and legal approach. **Do not angle across the centerline prior to reaching the turn off.** You will be violating a law and you may confuse approaching drivers. This confusion factor is one reason the angle approach was made illegal. If traffic is meeting you close give a hand and arm stop signal and stop, continuing to give your left turn light signal. When the way is clear, complete your turn, entering the side road on the right-hand side. Any public side road or crossroad along a main highway forms an intersection. And you should approach and turn at such intersections as you would approach and turn at an intersection of two city streets.

(5) In making a left turn when **traffic is heavy** in both lanes and vehicle **speeds are high** (40 mph to 55 mph), you may turn on the right-turn signal light, give the hand and arm slow signal, slow down, drive off the road onto the right-hand shoulder, and stop at least 100 feet from the intersection. This is a defensive procedure and is not required by law. Wait until there is a safe opening in the traffic stream in both lanes of the roadway, look both ways, give a left turn signal, and make a normal entry into the roadway; then enter the intersection and turn left into the side road. This procedure is important when a stop in the roadway for some time would create congestion behind you; this might cause a rear-end collision.

(6) When it is necessary to turn left from a highway on which traffic is heavy and fast, into a side raod on the near side of and close to the crest of a hill, or on the near side of a blind curve, the safest procedure is to drive beyond the hillcrest or beyond the blind curve to some place beyond a no-passing zone where there is a clear view in both directions, make a U-turn, drive back to the side road, and turn right.

b. Multilane highways:

(1) Three lanes.

(a) Approach to turn right in the extreme right-hand lane, giving a turn signal for at least 300 feet preceding the turn.

(b) Approach to turn left in the middle lane, giving turn signal for at least 300 feet preceding the turn.

(2) Four or more lanes.

(a) Approach to turn right in the extreme right-hand lane, giving signal for at least 300 feet preceding the turn.

(b) Approach to turn left in the lane next to the center stripe. If the highway is divided, turn from the lane next to the unpaved center strip or physical barrier, giving signal for at least 300 feet preceding the turn.

(c) Some multilane roads have extra, left-turn lanes at intersections. These lanes are rather short and you must be alert, check ahead, signal in advance, and slow down earlier in order to get into them safely. If an intersection is signalized you should look for a special signal light that controls movements from these left turn lanes. If there is no special signal lamp, a green arrow in the central signal lamp may control left turns.

(d) On a multilane road a signal light over any left turn lane may be red and prevent left turns while signal lights over the other lanes may show green arrows permitting traffic to move straight ahead or to turn right.

9. Turning from Side Roads onto Main-Traveled Highways

a. Right turns: First, look to see whether you will be entering a no-passing zone. Start the turn from the extreme right of the side road and complete the turn on the extreme right of the road you are entering. Shift into second gear before reaching the pavement. You might enter traffic faster if you use the shoulder as an acceleration lane and drive onto the roadway from the shoulder. However, if you do this you will be entering traffic from a shoulder and not making a normal right turn at an intersection. A normal turn is better unless it is less safe for some reason.

If traffic is approaching from your left, the nearest vehicle

should be about 1200 feet away, unless the left side of the road is clear so that it can pass you without having to brake suddenly before you can accelerate up to the normal speed of the traffic.

b. Left Turns: First, look to see whether you will be entering a no-passing zone. Start the turn from a position to the right of the center of the side road and turn onto the highway to the right of the center of the roadway. Exception: When entering a four-lane road with fast traffic approaching in the inside lane, you may turn into the outside or far right lane to avoid congestion in the fast lane. Avoid "cutting the corner" in making a left turn. Accelerate quickly if traffic is overtaking you.

c. Hazards in turning onto fast, two-lane highways:

(1) Car "A" entering a main highway from a side road may require a distance of 1,000 feet to accelerate to 55 mph. Car "B" approaching at 55 mph must be 929 to 1,010 feet from the side road when Car "A" pulls onto the highway, else Car "A" will force Car "B" to decelerate, unless the left side of the highway is open for "B" to overtake and pass. You therefore should not enter a two-lane road either right or left in front of a vehicle that will be forced to go around you, unless you know the left lane is clear for a safe overtake and pass.

(2) You cannot know the left lane is clear if you enter the highway toward a hillcrest within or near a no-passing zone. You should never turn right or left onto a highway toward a hill or curve within a no-passing zone unless an approaching vehicle behind you is far enough away that it can slow down easily and stay in line behind you through the zone. Look for no-passing lines before you leave the side road. If one is present and a vehicle is so near that it will have to cross the no-passing line to avoid hitting your car, wait until the vehicle has passed.

(3) After turning onto a main-traveled highway, make certain that you accelerate quickly to the speed that normal traffic is moving. Look for opportunities to blend your car into the stream of traffic with a minimum of interference to other vehicles.

(4) When you enter a rural roadway from a stop sign it will take you at least 2 seconds to get onto the roadway. If you turn right and accelerate from 5 mph to 55 mph at a rate of 4 ft/sec/sec it will take about 19 seconds to reach 55 mph. Your time from the stop sign is 21 seconds and the road distance you will cover is about 866 feet. A car approaching on your left at 55 mph (80.7 ft/sec) will go 1,695 feet in 21 seconds. In order for this car to continue at 55 mph and not get closer than 100 feet behind your car it will have to be 929 ft (1,695 minus 866 plus 100) from the side road when you leave the stop sign.

If you turn left you will take a least one second more to line up in the far lane. A car approaching on your right at 55 mph will have to be 80.7 feet farther away or a distance of 1,010 feet (about 4 city blocks) from the side road when you leave the stop sign.

If you poke along in high gear, the approaching cars will have to dissipate most of their speed. They may be expected to slow down some to cooperate with you. But if you have entered the roadway at 5 mph and it takes you 4 seconds to get up to 16 mph when a car speeding at 60 mph is, say, only 230 feet away, the car will have to brake at a rate of 16 ft/sec/sec down to a speed of 16 mph to avoid hitting your car. Decelerating at 16 ft/sec/sec is firm braking. It will throw children out of a seat.

Car Braking from 60 mph at 16 ft/sec/sec	
Time	Speed in Ft. per sec
	88 (60 mph)
1 Sec	16 72 ft/sec
2 Sec	16 56 ft/sec
3 Sec	16 40 ft/sec
4 Sec	16 24 (16.4 mph)

The braking car will travel 224 ft. in slowing from 60 mph to 16 mph.

Car Accelerating from 5 mph at 4 ft/sec/sec	
Time	Speed in Ft. per sec
	7.34 (5 mph)
1 Sec	4.0 11.34 ft/sec
2 Sec	4.0 15.34 ft/sec
3 Sec	4.0 19.34 ft/sec
4 Sec	4.0 23.34 (16 mph)

The accelerating car will travel 61 ft. in going from 5 mph to 16 mph.

If the other driver's reaction time is ¾ second his car will go 66 feet before he can start braking. The distance he has in which to slow down is 164 feet (230-66) plus the 61 feet you cover in accelerating. This makes a distance of 225 feet and he uses 224 feet. By the time you go 61 feet and reach 16 mph the other car will be only one foot from your rear bumper. This problem points up the error of entering a rural highway when fast approaching traffic is less than 300 feet away. This distance, safe in urban traffic, becomes very unsafe on rural roads.

d. Multilane highways:

(1) Three lanes

(a) In turning right enter the near outside lane. In turning left enter the far right-hand lane. Never turn into the center lane. Its use (at an intersection) belongs to vehicles making left turns off the three-lane road.

(2) Four lanes.

(a) In turning right enter the near outside lane. In turning left enter the lane that will cause the least interference with other vehicles. Observe the speeds and distances of approaching vehicles in each lane to decide in which lane your car will interfere less with the flow of traffic. If speeds of cars and trucks are about the same, favor large trucks because they congest traffic more when they have to slow down, and more important, they cannot brake as fast as cars and one might run into the rear of your car if you enter its lane when traffic is fast.

(b) If a four-lane highway is divided by a center strip that is **30 feet or more wide,** each side of the four-lane highway makes a separate intersection with the crossroad. You should approach the second half of the four-lane road as you would approach any other separate intersection. In making a left turn onto such a four-lane highway you should drive to the right of the point where the centerline of the crossroad intersects the divider's "curb" line of the roadway you are entering. (It would be like making a left turn from a two-way street onto a one-way street.)

(c) If the center strip is narrow, **less than 30 feet wide,** you should hold for a left turn in the same position as in the 30-foot strip; that is, on the right side of the centerline of the crossroad; but you need not go around the point as described in (b) above. In (b) you are holding outside of an intersection. When the strip is narrow you are holding inside an intersection, and when you make the left turn you have only to clear the end of the strip.

(d) When you enter across a narrow strip to make a left turn onto a four-lane highway and you meet a vehicle also making a left turn onto a four-lane highway, you may pass either to the right or the left of the meeting vehicle, whichever position the prevailing traffic makes safer or more convenient for you and the other driver. (Draw a sketch and locate the two points to the right of which left turns must be made and you will see it is legal to pass either to the right or left side of a meeting vehicle. When a strip is narrow only one intersection is formed between the crossroad and the four-lane highway.)

(e) When you are making a left turn onto a divided highway (narrow strip) and a driver approaching from your right wants to turn left onto the crossroad (you would be entering the lane he is leaving), you may drive either to the left or to the right of the other vehicle.

(f) If you and another driver are turning left as described in (e) above and the strip is **30 feet or more wide,** both of you must drive to the right of the point where the centerline of the crossroad crosses the strip's "curb" line of the roadway you are entering.

10. U-Turns

a. U-turns are illegal on curves and near hillcrests or on approaching grade where vehicles cannot be seen from either direction within 500 feet. Any turning may increase confusion for other drivers. The greater the degree of turning the more the confusion. This is one reason U-turns are prohibited where other hazards already exist.

b. U-turn where traffic is not heavy: You should check traffic behind, pull off onto the right shoulder, swing wide slowly, and stop at a 30-45° angle to the roadway with left front wheel at least 4 feet from pavement edge; while stopped here hold a hand and arm stop signal, if a vehicle to the rear is close. You should check traffic to front first and then to the rear by looking out of the driver's window. (Checking traffic in rearview mirror is not sufficient.) If traffic is clear 600 feet to the rear and 1,200 feet to the front, you may start in low and complete a U-turn on the pavement, shifting into second gear and accelerating as soon as you get straightened out in the right lane.

c. U-turn where traffic is heavy: Stop at a 30-45° angle to and 4 feet from the pavement to check traffic; while stopped here hold a hand and arm stop signal. Wait on shoulder until a short break in traffic develops for at least 300 feet to the front and rear. Drive quickly straight across roadway in low gear to opposite shoulder. Stop parallel to, and 4 feet from, the pavement and give a stop signal. You should then wait until you can enter traffic safely, following the normal procedure prescribed for entering a roadway from a shoulder.

d. You should go to the opposite shoulder before entering traffic, if when you are in the 45° position your view up the road to your right is obstructed. If you complete the U-turn in one maneuver, a fast vehicle you could not see approaching might run into you, or be forced off the pavement to miss both your vehicle and a vehicle coming from the opposite direction.

e. Sometimes traffic and road conditions on a main highway warrant going onto a side road and returning to enter the highway (in a right or left turn) instead of attempting a U-turn on the highway. In deciding whether to go up a side road to the right or left, consider whether the left turn you will have to

make would be safer in leaving the highway or on reentering the highway. Ordinarily it will be safer to leave the highway in a right turn and reenter in a left turn, since you would not then obstruct traffic while waiting to start the exit left turn.

f. To make a turnabout on the side road you should either pull into a driveway or lane, or select a place from which your view is unobstructed for 500 feet in each direction. If the side road is narrow, you will be obstructing the road for some time and you will be in danger if you turn near a blind corner or hilltop. In making a turnabout in the roadway use your parking brake to help keep your rear wheels on solid ground and to avoid rolling into a ditch. You should clear traffic before changing direction to start the turnabout.

On a narrow road start a turnabout on the extreme right side of the roadway. You may go forward across the road cutting your wheels sharply to the left until you almost reach the far side, at which point you can straighten up the front wheels. Look back, and as you start backing cut the front wheels sharply to the right. If the borrow ditches are deep, look back out of driver's window to make sure your left rear wheel stays on solid ground. As you come to a backing stop, straighten up the front wheels and cut them to the left as you drive forward.

Another method is to start the turnabout by first backing across the road. This method would be better if the borrow ditch on the right is deep or soft and the one on the left is shallow or firm. Backing first would then expose your rear wheels to less danger of getting stuck.

11. Overtaking and Passing Problems on Two-Lane, Two-Way Roads

a. Accelerated pass: You start the pass at the same speed the vehicle ahead is going and you increase your speed up to 15 mph faster during the pass, provided you do not exceed the legal speed limit. This amount of speed increase is considered a safe limit. As you increase the passing speed you increase the danger of driving into a hazard (beyond the vehicle) which you could not see when you started the pass. This hazard might be an animal running across the highway from the right shoulder. If you are overtaking a panel-or van-type truck which can hide a large area from your view, you are move likely to drive into a trap in a high speed pass. Since you should be on the left side of a two-lane road as short a time as possible, a safe pass becomes a compromise between the time on the left side and the amount of excess passing speed. To effect a safe compromise you may accelerate before you start the pass and make a constant speed pass instead of chugging out from the rear end of a vehicle to start an accelerated pass. The average accelerated pass for most vehicles will require 12 seconds. A constant speed pass will reduce this time. A car in overdrive will increase the passing time in an accelerated pass. The automatic kick-out takes longer and you may fail to kick it out. If your car has overdrive and you must make frequent passes in heavy traffic, disengage the overdrive. To do this while moving, push the gas pedal to the bottom and pull out the overdrive handle to lock out the overdrive. You can accelerate and brake faster with the overdrive out.

b. Constant speed pass: You are already traveling 10-15 mph faster than the vehicle ahead when you pull out to go around. The average constant speed pass will require 9 seconds. If an accelerated pass would have resulted in a head-on collision or a run-off-roadway, the constant speed pass might provide the extra room needed to complete a pass. The danger of a constant speed pass lies in the fact that if there is not room enough to make any type of pass, the higher speed of a constant speed pass might turn an injury accident into a fatal accident.

c. Passing distances:

(1) Accelerated pass. If you and the vehicle you are following are going 45 mph when you start an accelerated pass and a meeting vehicle is coming 55 mph, the meeting vehicle should be 2,044 feet away when you start the pass. This distance is determined as follows: Road test indicate that if you allow desirable clearances, it will take you 12 seconds to make the pass from the time you start across the centerline until you cross the centerline in completing the pass. You will average 50 mph for 12 seconds and travel 876 feet. The meeting car traveling 55 mph for 12 seconds will cover 968 feet. These two distances plus the 200-foot clearance between meeting vehicles, required by law, totals 2,044 feet. In this distance 120 cars could be parked bumper to bumper.

(2) Constant speed pass. If you are going 55 mph overtaking a vehicle going 45 mph and, with desirable clearances, you make the pass in 9 seconds, you will cover 726 feet. In 9 seconds a meeting car coming 55 mph will cover 726 feet. These two distances plus a 200-foot clearance between meeting vehicles, required by law, totals 1,652 feet, the distance from you that the meeting car must be when you start the pass. This is 440 feet less than is required by an average car in the accelerated pass. A car with high horsepower can reduce the distance in the accelerated pass, but the relative advantage of the constant speed pass holds for any given car.

d. Passing judgment:

(1) Obviously the ability to judge speed and distance in passing is vital on two-lane roads. If your visual acuity is low or your depth vision judgment is poor you should never attempt a normal overtake and pass when a meeting vehicle is in sight.

(2) If you have good vision and you "think you can make it," decide quickly that you will wait, because if conditions

are such that you have taken time to "think I can make it" you have already used up your safety margin time in "thinking" and you may be heading for a serious collision if you try.

(3) If a doubt that you can make it creeps into your feelings, it is Nature warning you to stay in line. If you ignore this "feeling," and start around, this "doubt feeling" may so absorb your attention that you will panic. If you panic you may not be able to control a hand or foot for several seconds. No driver knows whether or not he will panic under conditions which he has never experienced.

(4) Probably all of the thousands of drivers who have committed motorcide in head-on collisions thought they could make it. The many wasted lives, sacrificed to poor passing judgment, is irrefutable evidence that it is wiser to "waste" a few seconds waiting for an opening which you know is safe. If for some reason a driver is unable to tell whether it is absolutely safe to pass when a vehicle is meeting him, that driver should never pass unless he can see that the left lane is open for a distance of one-half mile. If a seeing defect is the reason he cannot tell whether it is safe to pass, he probably cannot see to judge an object one-half mile away. A person with such a defect probably should not drive and certainly should never overtake and pass on rural highways carrying fast traffic.

(5) You, who can see well, must not assume that all other drivers you are meeting can see you as well as you can see them. You must prepare to compensate for a meeting driver who indicates that he may start a hazardous pass. If you do not base your planning on the possible defects of other drivers, you will be letting your advantage of good vision lead you into a trap. This in itself would be poor driving judgment.

(6) Errors in passing judgment frequently harass some drivers because they cannot judge the speed and distance of an object coming straight toward them. This is a common problem caused by a natural limitation of every person's vision. A driver must discipline himself to wait for an obviously safe opening, because the odds are long in favor of a close decision being fatal. Vehicles traveling 60 mph in opposite directions with only a two-foot center clearance constitute a built-in hazard resulting from a horse and buggy custom. To permit modern high speed vehicles to use the lane of opposing traffic to overtake and pass is a folly of the auto age. You are an heir of these two errors when you drive on a two-lane, two-way road. It takes only a slight additional error to kill an entire family.

12. Overtaking and Passing Procedures

a. On a two-lane highway:

(1) Check the rearview mirror frequently for a car that may be starting to overtake and pass you. Even though the driver does not sound his horn you should know he is there. If you know he is there you can give way, and if necessary you can leave the pavement to escape a passing trap. When a driver behind indicates he will pass, ease to the right side of your lane. Always cruise in the center of your lane so a driver behind can see down the left lane.

(2) When you are preparing to overtake and pass, drive slightly to the left, just far enough to enable you to see the left-hand lane clearly for half a mile or more ahead. If you are not following too close, you should be able to see down the left lane without crossing the centerline. Ducking out suddenly from close behind a vehicle may cause a meeting vehicle that is close to run off the road. You know you do not intend to pull out but the other driver does not know this when he sees a fender of your vehicle cross the centerline, and he cannot afford to depend upon your pulling back. When checking the left lane around a truck, count the vehicles you can see and wait until this number pass before checking again. This will decrease needless dodging back and forth.

(3) Let there be no doubt in your mind as to whether a vehicle approaching from the opposite direction is near enough to interfere with your passage. If you start, and doubt forces you back just behind the vehicle in your lane, drop back about 50 feet to permit room to clear and to accelerate again before starting around on a second try.

(4) Make sure that you will not reach an intersection, railroad, bridge, or tunnel while you are on the left side going around the vehicle ahead. And avoid coming abreast of the car you intend to pass near a car parked close to the pavement, especially if the roadway is narrow.

(5) If conditions of the roadway, weather, or traffic indicate that passing is hazardous, sound your horn long enough to give the other driver ample opportunity to hear it, but not long enough or loud enough to be a nuisance. If a horn signal is needed it is important that you know the other driver has heard your signal, before you pull alongside his vehicle. The driver of a noisy truck may be unable to hear a horn signal. When a truck cab is closed a driver might not hear even a siren.

(6) If the left lane ahead is clear, give a left turn signal, **glance left to see the lane is clear,** and cross gradually onto the left lane of the highway, beginning 50 to 75 feet behind the vehicle to be passed and completing the crossing of the centerline 20 to 30 feet before catching up with the vehicle to be passed. Approach the vehicle ahead at a speed 10-15 mph faster than it is traveling. Avoid driving too close to a car ahead before pulling out to pass. If you have misjudged the clear distance, if another vehicle pops

up in front of you from a side road, or if the driver you are overtaking accelerates, this precaution will give you more maneuvering room to get back in line behind the car you are overtaking. Otherwise, you may have to resort to emergency braking or take off onto the left shoulder, which may not be there.

(7) If the vehicle ahead is in the center of its lane or has given way to the right, keep your car in the center of the left lane. If the vehicle ahead is riding the centerline and does not give way after you sound your horn, you should steer to the left side of the left lane in order to leave ample clearance between the two vehicles. The other driver may be day dreaming and upon hearing or seeing your vehicle he may unintentionally veer his vehicle to the left.

(8) Even if the left lane is open, a slow overtake increases the danger of meeting a car on the left side. Form a habit of making all passes as if you were meeting a vehicle. This practice will help you avoid a poor habit which may get you into a trap later on. Furthermore, cars have a habit of appearing suddenly from nowhere. This is one of the phenomena of traffic that continually perplexes drivers.

(9) Finish passing as promptly as possible and get back on the right-hand side of the roadway. When you can see the reflection of the car you have just passed in your rear-view mirror, it will be safe to drive into the right-hand lane. Or you can look back to the right to clear. If a meeting vehicle is near, you should look to the right and get back on the right side as quickly as possible. If you delay you may wind up on the shoulder in a head-on collision with the meeting driver, who left the road to miss you at about the same time you left the road to miss him. Delayed deciding definitely dictates destruction. You are the one who placed yourself in an illegal position and it is your responsibility to get out of the left lane quickly.

If you cut back to the right lane at too sharp an angle, especially on a slick road, there is danger of going into a skid. If you do not know how to recover or if you panic, you may lose control and end up turning over or fishtailing into another vehicle, a tree, or a bridge head. These are common results of passing ignorance. The cut-back skid hazard is much greater downgrade on wet pavement. The wet road hazard is greater still if you are driving a car with high horsepower. A sharp cut back in a car with high horsepower on a wet pavement downgrade can start a ground loop faster than a driver can say, "I didn't know–!"

(10) Sometimes it may be necessary to overtake two or more vehicles in one pass. Sound your horn for each car to prevent any of the drivers you are overtaking from pulling out to start a pass. If a driver does pull out ahead of you, the safest procedure is to pull into the space he vacates, because two or more vehicles passing two or more vehicles is making a two-way highway into a one-way roadway. A traffic riot is in the making. Don't help it along.

(11) When overtaking and passing on a road covered with loose gravel, you should not cut back in front of the car you are going around until your car is out in front of that car far enough that your car's rear wheels will not sling rocks against the other vehicle. When planning to overtake the pass under such conditions you should allow for the extra time you will be on the left side of the roadway.

(12) If you are going 55 mph overtaking a vehicle going 45 mph, that vehicle is leaving the point where you cross the centerline at a rate of 66 ft/sec.

If you are going 55 mph overtaking a vehicle going 15 mph, that vehicle is leaving the point where you cross the centerline at a rate of 22 ft/sec.

The smaller the difference between the speeds of you car and the other vehicle, the less important it is to start a pass 50 to 75 feet from the vehicle ahead, so far as maneuvering room is concerned. (The advantage of seeing farther down the left lane still holds.)

The greater the difference between the speeds of your car and the other vehicle, the more important it is to follow the rule of starting a pass 50 to 75 feet from the vehicle ahead.

The fact that you cannot at a given cruising speed start overtaking vehicles traveling at various speeds from the same point with equal safety is very deceptive. In this fact lies one danger of overtaking at a speed much higher than the vehicle ahead is traveling. (The other danger is discussed elsewhere.) Consider a speeding driver going 75 mph (110 ft/sec) who starts a pull-out to pass a slow (15 mph) vehicle at a point about 25 feet from the vehicle, a distance he is in the habit of leaving between his car going 55 mph and a vehicle ahead going 45 mph. He doesn't clear the slow vehicle simply because the 25 feet plus the distance the vehicle's clearing rate provides is so short that his car going 110 ft/sec covers the distance in 0.4 of a second. The driver hardly has time to take up the slack in the steering wheel. This is another example of how high speed causes drivers to commit position violations. In this example, the driver fails to pass to the left as required by law.

(13) If you want to improve passing judgment, spot a meeting car which you think is far enough away for you to make a constant speed pass. Note the car's distance from you and its apparent size and motion. Count 1,001 — 1,002 — 1,003, etc. up to 9. When you reach 9, note variations in the locations of the cars and in their speeds as they go by you. This practice will help you judge how far away a car moving at a normal speed must be, and it will also point out how dangerous your pass could be if a meeting car is speeding. Here, incidentally, is one of the built-in hazards of high speeds on two-lane roads. A car far enough away for you to start an overtake and pass is too far away for you to tell whether it is going 55 mph or 80 mph. You have a right to expect the car to be traveling at a legal speed. If all cars approach you within known speed limits, you can become more adept in passing judgment. Likewise, if you drive within legal limits, you will help other drivers avoid errors.

(14) In addition to judging the distance and speed of a meeting vehicle before deciding to pass, you should always glance down the left shoulder for hazards that would endanger your escape should trouble develop during the pass. These hazards include trees, rough ground, steep banks, guard posts, pedestrians, animals, and parked vehicles.

(15) Overtake and pass problem: If you are going 55 mph (80.7 ft/sec) overtaking a truck going 45 mph (66 ft/sec) and you pull out to pass at a point 50 feet behind the truck, how many seconds will you be on the left side of the road and how long a road distance ahead must be clear when you start the pass? Assume that your car's length is 18 feet, the truck's length is 50 feet, and that the rear of your car is 50 feet ahead of the truck when you start to cut back across the centerline going back to the right side. You now have 50 feet, plus 50 feet, plus 50 feet, plus 18 feet (the length of you car), plus 20 feet (10 feet between centers of the two lanes which you must cover in starting and ending the pass) for a total of 188 feet, distance of overtake. Your rate of overtake is 14.7 feet per second (80.7-66).

$$\text{Time of overtake} = \frac{\text{distance of overtake}}{\text{rate of overtake}}$$

$$= \frac{188}{14.7} = 12.79 \text{ seconds}$$

$$\text{Ground distance to overtake} = \text{speed} \times \text{time}$$

$$= 80.7 \times 12.79$$

$$= 1032.2 \text{ feet}$$

The road distance that must be clear for your car is 1,232 feet, 1,032 plus a 200-foot clearance you must leave between your car and the meeting car, required by law. If a meeting vehicle traveling 55 mph is approaching when you start the pass, it will have to be 1,232 feet plus 1,032 feet, or a distance of 2,264 feet down the highway, .43 mile.

If you make an accelerated pass in an average car, starting at 45 mph and accelerating to 55 mph, it will take about 12 seconds at an average speed of about 73 ft/sec, for a ground distance of 876 feet. If a meeting vehicle traveling 55 mph is approaching when you start the pass, it will have to be 2,044 feet away (876 plus 968 plus 200-foot clearance). This is .39 mile.

(16) When it appears that you will meet a vehicle near a slow farm machine ahead of you in your lane, you should approach the machine as if it were a fixed object in the roadway. Give attention to stopping rather than passing.

b. On a three-lane highway:

(1) Follow the general procedure for a two-lane highway. You may "overtake and pass" on the right of a vehicle which is using the center lane in a approach for a left turn. If a driver in the center lane is not planning to turn left, he should be trying to get back into the right lane. You should not speed up and delay his return to the right lane. If two opposing drivers, overtaking and passing in the center lane, endanger one another, the driver who entered the center lane last should yield.

(2) The middle lane should be used only for passing and in approaching for a left turn. A passing maneuver should end before you reach an intersection so that opposing traffic may use the center lane for a left turn.

(3) If two or more vehicles you are meeting are close together, observe closely for any indication that one of the vehicles following might enter the center lane to pass at the same instant you enter the center lane. The fact that this coincidence is rare is evidence that the poor drivers need and receive a lot of help from the good drivers.

(4) If possible, plan a pass so that your car will not be abreast of two vehicles going in opposite directions, especially if traffic is fast and the lanes are narrow. This precaution is more important when one of the two vehicles is a bus, truck or other wide vehicle. Delay the pass if traffic is congested in your cruising lane. You may be unable to return to your lane.

(5) When passing more than one vehicle, you should not stay in the center lane so long as to deprive some opposing driver of its use. After a reasonable time in the passing lane you will be guilty of cruising in the center lane, an illegal practice. If two drivers are meeting in the center lane and one driver is not overtaking and passing or preparing for a left turn, this driver must yield even though he entered

the center lane first, because he is in the center lane illegally.

(6) Three-lane roads always end. Look for a sign that will warn you of a transition from the three-lane road to a two-lane road. Do not start a pass you cannot complete before you reach the transition point. If you are caught in the center lane and you cannot complete your pass on the left side of the two-lane road, you should stop at the end of the center lane and enter an opening in traffic in the right lane of the two-lane road.

c. On a four-lane highway:

(1) On a four-lane highway you may overtake and pass in either lane. If you want to drive faster than vehicles using the slow lane, yet under the speed limit, you should drive back into the right lane immediately after passing a vehicle moving in the right lane. You then will not obstruct the way of vehicles traveling at speed limits and cause them to change lanes in order to pass you. If, however, there is no traffic overtaking you in the fast lane, you may stay in the fast lane. The more closely a car you are passing is following another vehicle, the more alert you should be to the car's moving into your lane.

(2) On an **undivided** four-lane highway you may overtake and pass in either lane. You should never drive onto the left side of the centerline or onto the right shoulder to overtake and pass vehicles. When you are in the inside lane you should be alert for some "two-lane" driver (meeting you) who may cross the double center stripe to overtake and pass. It does happen. If you are in the outside lane when that happens to another driver, you must be ready to go to the shoulder to prevent the driver in the inside lane from sideswiping you when he tries to dodge this "two-lane" passer. (A "two-lane" driver is one who has driven so long on two-lane roads and has formed such a fixed habit of passing only on the left that he cannot adjust to driving procedures on multilane roads.)

(3) When a car some distance in front of you is slowing down or is waiting for a left turn, check the opposing traffic ahead of the car turning left and reduce your speed so the turning car will clear your lane by the time you get to it. This traffic check and speed adjustment, if done regularly, may prevent your overrunning a car slowing to turn left or prevent your having to change lanes suddenly to overtake and pass the car on the right. Sudden lane changing without signaling and looking to the side is a dangerous practice.

(4) The clearance problem in overtaking and passing discussed in 12.a. (12) is a common factor in sideswipe collisions from the rear on multilane highways where speeding in passing may be more frequent. The differential in vehicle speeds created by speeders and slowpokes is an inherent hazard of unsupervised traffic, at which minimum and maximum speed limits are directed.

d. Passing on the right side of a vehicle is legal in Texas in the following instances:

(1) The overtaken vehicle is making or about to make a left turn.

(2) The roadway is of sufficient width for two or more lines of moving vehicles in each direction and said roadway is unobstructed.

(3) The roadway is an unobstructed one-way roadway of sufficient width for two or more lines of moving traffic.

(4) The law specifically sets out that these movements may be made only under conditions permitting such movements IN SAFETY, and, in no event shall such movements be made by driving off the pavement or main traveled portion of the roadway.

(5) While passing on the right is legal in the situations described above, it requires caution for two special reasons. First, many drivers think it is illegal and may not hesitate to change lanes to the right in front of your vehicle without giving you a second thought, because they think you are required to pass only on the left. Second, you are on the "blind" side of the driver and this makes it more difficult for him to see a vehicle on his right. Many drivers have not learned to look to the side before changing lanes. In passing on the right keep alert to the position of the vehicle you are passing and be ready to hit both your horn and your brake in a split second. If it appears you may need to hit your brakes, check your mirror before you start the pass. If a car is close behind you warn the driver with a slow signal.

(6) Some two-lane roads have been made into four-lane roads by the addition of new paving. Shoulders improved by paving can be confused with these extra lanes. You should make sure whether the added paving is a traffic lane before driving or passing on it. Signs may indicate whether or not it is a traffic lane.

13. Parking

a. Illegal parking practices listed under City Driving apply to rural highways.

b. In making a routine stop select an area where your parked car can be seen for a distance of 300 feet by drivers approaching from either direction. An area near a straight level

road is best, provided you can get your car four feet from the pavement. An area at the top of a hillcrest is least desirable, unless the shoulder there permits you to park 15 or 20 feet from the pavement. A wide shoulder on a hilltop would be better than a narrow shoulder on a level road where you could barely clear the pavement. Your job is to park so meeting drivers not only can see your car but also can see each other in time to decelerate if a traffic hazard develops near your car, and to remove your car far enough from moving traffic to prevent its being a real or mental hazard to other drivers. Just off the pavement on a blind curve or a hillcrest would therefore meet these needs the least.

c. A rule such as "use common sense" is as poor a guide in safe parking as it is in safe driving generally. An adult driver with a carload of passengers stopped in the middle of the traffic lane on a winding road to check his tires. There was a level, graveled shoulder 20 feet wide beside the pavement. An officer, after having the driver remove his car from the pavement, asked why he had not parked on the shoulder instead of stopping in the traffic lane. The driver told him, "I just didn't want to get my new car off on that old gravel." The driver's decision to park on the clean pavement instead of the dusty gravel might have been "common sense" to him, in spite of the fact that the public at considerable expense had provided an all-weather shoulder for this man's convenience and everybody's safety. "Common sense" parking may be suicide. Forget it. Just get way off the pavement at a place where meeting drivers can see you for some distance and also can see one another.

d. If you want to park near a bridge, stop at least 50 feet away, and if the bridge is no wider than the pavement, stop farther away still. Bridgeheads are hazardous objects for traffic and the closer they are to the pavement the more accidents they cause. This is why the traffic law prohibits a driver approaching a bridge from driving on the left side within 100 feet of the bridge. Passing on a bridge and on leaving a bridge are legal, unless passing is prohibited by a sign or a no-passing marker. It is the approach to a bridge that is bloody with human sacrifice to "common sense." On the approach is where drivers usually panic and collide with each other or the bridgeheads. If the bridgeheads are wide, parking 50 feet away from the bridge is safe. If the bridgeheads are narrow, back off farther unless you can park over 12 feet from the pavement. Good procedure requires you to park at least 50 feet from a bridge, but the farther your car is from the bridge and from the pavement the safer your car will be.

e. In preparing to park, check rear traffic and give a slow signal at least 300 feet from the spot you intend to stop. If opposing traffic on a two-lane road will prevent vehicles behind you from passing you, you should decelerate only slightly at the beginning of the approach to your parking spot and as you draw near it decelerate smoothly but as rapidly as safety to your passengers will permit. To reduce congestion further, about 100 feet from the spot you can go onto a good shoulder at 15 to 20 mph instead of pulling down to a near stop in traffic before turning out.

f. At night flash your stoplight three times when you start braking to attract attention of drivers who may not recognize a stoplight as such unless they see it come on.

g. While parked, keep passengers on the right side of the car. Insist that they not stand directly behind or on the traffic side of the car. Keep pets off the roadway. At night keep parking lights on and use a flashlight to light up a person who is repairing a tire on the traffic side. If visibility is poor, as in dust, rain, heavy mist, or fog, **keep the low beam headlights burning,** day or night.

h. Set your hand brake and cut ignition if you get out. Look back before opening a left door and step out forward when the way is clear. Opening left doors with your right hand will cause you to face traffic as you step out. If you must park near the pavement when traffic is heavy, get out on the right side.

On either upgrade or downgrade turn the steering wheel to the right so that your vehicle would roll away from traffic in case a child should release the brake. Learn how to tell whether and how the front wheels are cut by the position of the steering wheel. If the grade is steep, or the vehicle is heavily loaded, shift gears to low (upgrade) or reverse (downgrade) and chock the wheels, rear wheels upgrade and front wheels downgrade. If gear is in overdrive, disengage.

i. If you need to park on the opposite side of a roadway at night, as when the shoulder on your side is poor, make a U-turn so that your car lights will not confuse the drivers as to which side of the road your are on.

j. If you have a flat tire on or near a bridge, near the crest of a hill, or on a blind curve, and there is not shoulder room to get off the pavement completely, you should run on a flat tire until you find a place to leave the roadway. If your car stalls in one of these dangerous places and passengers have to push your car, have them push from the right side. Do not let them get behind your car or on the traffic side. If it is physically impossible to move a stalled car, such as when a wheel comes off, you should immediately have a passenger flag traffic at a point beyond any nearby view obstruction such as a blind curve or a hillcrest, and at least 100 steps from your car anywhere. If you are alone, you should flag the traffic overtaking you in your lane until you can get help to move your car off the roadway. Flags and reflector flares as well as a flashlight should be in every car. Check the flashlight before starting a trip over rural roads at night.

k. Extra traffic lanes added to an old two-lane road may appear to be paved shoulders. Do not park on one of these addi-

tions unless you know it is a shoulder. If there is a place to park off the improved addition or if the paved addition extends across culverts you should assume that it is a traffic lane. If a double centerline divides the roadway, you may be sure the improved addition is a traffic lane.

14. Backing on a Rural Highway

a. Backing maneuvers are discussed generally under City Driving because most backing is done on city streets. Since drivers do most of their backing on city streets where speeds are relatively low they may not be aware of the hazards of backing on a rural highway where speeds are high. One of the rural hazards is the fact that when a driver needs to back in rural traffic, the occasion is so rare that he is likely to execute the maneuver with precautions similar to those he employs in city traffic. If he does he is likely to be clobbered. Vehicles approaching him on a rural highway will be traveling about twice as fast as vehicles on a city street. This fact alone makes backing in rural traffic at least twice as hazardous. But this speed factor is only half the added hazard of rural backing. The other half is the part that a backing driver may overlook. When a driver speeding at 60 mph recognizes that he is endangered by a backing vehicle, he must have twice the distance to react and four times the distance to brake as he would need in city traffic in order to avoid a collision.

b. Restricted sight distances aggravate the speed and stopping hazards. Backing near a hillcrest or a blind curve is very dangerous. Next worse is backing in restricted areas such as on or near bridges, in no-passing zones, or when traffic obstructs the other lane.

c. It is illegal to back a vehicle upon the shoulder or roadway of any controlled access highway according to Texas law.

d. If while moving forward you decide to stop and back up for any reason, the first thing you should do, especially if an overtaking vehicle will reach you while you are backing, is to go onto the shoulder. This precaution will serve you two ways. First, it will enable you to check traffic properly, after you stop and from a safe and legal position. Second, once you are on the shoulder, you will likely decide to do your backing on the shoulder.

NIGHT DRIVING

1. The Problem

a. The National Safety Council estimates that on a vehicle-mileage basis, two to three times as many traffic accident deaths occur at night as in daytime. Nighttime, therefore, is a major factor in the severity of accidents.

b. Night hazards increase as a driver's ability to identify objects decreases. When light conditions are poor the eye sees more slowly and causes the brain to lag in making decisions. A driver must compensate for this brain lag by reducing his speed and by concentrating both eye attention and mind attention on the roadway. Concentrating eye attention does not mean fixing your eyes on an object, but rather keeping your eyes moving over the traffic scene, front, side, and rear.

c. Most day hazards are present at night, but a driver may not bother as much about things he does not see. A driver sees so much less at night he may feel more secure than in daytime. He may therefore select a cruising speed that fits the traffic conditions he sees rather than a speed that is safe for traffic conditions that exist. A driver who can select a proper speed by day may fail to do so at night because the eye-brain stimuli from existing hazards are missing. It is difficult to translate this concept into self-discipline.

d. A well-lighted vehicle is the only advantage night driving has over day driving. Good lights make a driver aware of a vehicle beyond the crest of a hill, around a blind corner, behind trees in mountains, and ahead and behind him on level, straight roads. But this advantage can be a hazard because the lighted vehicle may cause him to overlook unlighted hazards or to forget the presence of those hazards which he can never see in time to avoid, if he is driving at a speed too fast for existing conditions. The increase of severity of night accidents indicates that collision contacts are made at higher speeds. It follows that drivers simply do not have as much time to reduce speed before contact after they see, if they do see, that a collision is imminent.

2. Check Vehicle Lights and Clean Window Glass

a. Headlights (both beams)

b. Red taillights and white license plate light

c. Stoplights (red or amber)

d. Directional turn indicators (if you use them in signaling)

e. Instrument panel lights

f. If any of the above lights are defective, have them repaired as soon as possible. If all lights are out (and starter will work), a short may be causing the circuit breaker to cut out or a fuse may be burned out.

g. Clean windows and lights can greatly increase your visibility at night.

3. **City Driving at Night**

a. The state law requires you to keep lights on low beam when vehicles meeting your are within 500 feet. (This law applies on rural roads also, but on rural roads your high beam may blind a driver 2,000 feet away. Lower your beam when he signals for dim lights.) Unless an ordinance of the city in which you are driving requires low beams at all times, high beams may be used when there are no approaching drivers meeting you. Low beams are required when you are following a vehicle within 300 feet.

b. Turn on lights before starting if dusk is approaching. The law requires lights burning from one-half hour after sunset to one-half hour before sunrise, and during daytime when a person or vehicle cannot be seen 1,000 feet away. Keep all lights and car glass clean for good visibility. You can easily hit what you can't see. A dirty windshield can hide a slick place at night which it would not hide in daytime. Dirt particles reduce visual acuity and increase eye fatigue.

c. Do not wear sunglasses at night, at dusk or in daytime when visibility is low. Ease eye fatigue by moving and blinking eyes frequently. Avoid looking through the curved portion of a wrap-around windshield to judge distance and speeds of vehicles, as when waiting at a stop sign. Avoid looking at bright lights anywhere while driving at night so as to keep your eyes adapted to the dark. Keep panel lights dim. Close one eye when your eyes are momentarily exposed to a bright light so as to keep one eye adapted to the dark.

d. Watch for pedestrians and bikes on curbs or walking at edge of roadway. A pedestrian who is in the beam of your headlights usually will assume that you can see him. This error causes many deaths. When you are walking and headlights are on you, note how the beams reflect a few inches from your body to your eyes and make you appear lighted up to yourself. It may appear to you that the driver surely must see you as well as you see yourself. You may feel more conspicuous than you would in daytime in the same spot, while actually the driver may not see you at all. This experience as a pedestrian also makes you as a driver think that anytime your light beams strike a pedestrian you will be able to see him. Many dead pedestrians would disagree.

e. If blinded by other lights, immediately reduce the speed of your vheicle. On city streets you do not have a shoulder on which to escape.

f. Watch for lights burning on parked cars. A car light is a good indication the car is occupied and may pull away from the curb.

g. Slow down and check crosswalks carefully in misty weather when headlights are on low beam. If the pavement is dark and a pedestrian has on dark clothes, you may never know he is walking into the path of your car until you hit him.

h. In starting up an abrupt grade with lights on low beam you may easily overdrive your headlights because the beam will not reach very far along the roadway. If the pavement is dark colored, a pedestrian in dark clothes walking in or near your lane may be completely hidden from veiw. You should switch to high beam at such a place unless you are meeting a vehicle, in which case a reduction of speed is your only recourse.

i. Lower your headlights or use parking lights while parked, even during short stops while loading or unloading or waiting for passengers. Unless angle parking is permitted try to get two wheels within six inches of the curb. A driver who parks his car at all sorts of angles with a curb demonstrates selfishness or a lack of discipline. A street is intended primarily for moving vehicles. The very least a driver can do to display a willingness to share the road with others is to park his car so as to leave as much street space as he can for moving vehicles. A parked car blocking just one foot of street width it doesn't need can create a bottleneck in the flow of traffic. It may force one lane of traffic to stop every time opposing vehicles meet near the parked car.

4. **Rural Driving at Night**

a. Do not overdrive your headlights. Good visibility on high beam may vary from 250 to 300 feet. It will be better on a light colored pavement and shoulder. Fifty-five mph is a safe speed for a car with a good high beam and good brakes on a straight, level road with light colored pavement and shoulder, provided the driver is in good physical condition and concentrates attention over the traffic scene along and on the roadway. Speed should be reduced on low beam unless you are following (at a safe distance) a vehicle whose headlights help light the roadway and shoulder for you. When your are not following a vehicle beams of opposing vehicles may silhouette obstacles for you.

b. If an approaching driver fails to lower his headlights, signal to him by switching high beam on and off quickly. The driver may not be giving eye or mind attention to the roadway. This signal may alert him as well as get him to lower his lights. Keep your lights on low. You may be able to drive against a high beam better than the other driver. Your high beam may cause him to get into your lane. Your job is to get by him safely. Improperly adjusted headlights a half mile away may shorten a driver's seeing distance and require the victim to reduce his speed. If lights are lowered when vehicles are a half mile apart, speeds will have to be reduced to avoid overdriving headlights. If lights are properly adjusted drivers can lower the beams when 1,000 feet apart. Many drivers with poor glare recovery may be partially blinded by your lights. If an oncoming vehicle starts to pull toward you, immediately drive onto the right shoulder, or into a ditch if necessary. Your headlights may be causing the driver's erratic steering.

c. When meeting bright lights at night, look across your car hood toward the right edge of the pavement. By checking the position the pavement edge cuts your hood during day driving when your car is properly positioned in the middle of the traffic lane, you will know at night where to hold your car until the bright lights have passed.

If blinded by oncoming lights, ease off accelerator and glance along the right edge of the pavement across the hood to be sure you keep in your lane. Keep calling for dim lights. Go onto the shoulder and stop, if necessary, until the car passes and you can see clearly again. Avoid anger, which may cause you to become defiant and leave your lights on high beam, instead of slowing down and going to the shoulder if necessary to maintain steering control. Anger may blind you more than the lights. Slowing down is the first and most important thing to do. It may save your life if later on leaving the roadway you should hit a fixed object.

d. Turn on your low beam headlight before dusk. Although you may see objects at dusk 300 feet ahead as well without lights as you can with lights, a driver meeting you and starting a pass must be able to see your car for 2,000 feet before starting a safe pass. You cannot understand this problem unless you have learned to look at driving problems from the position of the other driver. Here lies one of the big differences between trained and untrained drivers. You, therefore, must keep a sharp eye ahead at dusk to detect the untrained driver who may be passing in your lane without lights.

Do not depend upon parking lights as dusk approaches. Parking lights may not identify your car to a meeting driver if he has already turned on his headlights, especially if his lights are on high beam. For this same reason you should keep your headlights on low beam as long as it is at all likely that a meeting driver may be driving with parking lights. Usually you should use low beam in heavy rain, sleet, snow, fog or, dust in nighttime as well as daytime. If you are driving at 55 mph when dusk approaches you will be wise to reduce your speed to 50 mph during dusk and return to 55 mph after it is completely dark.

e. Keep lights on low beam when following or overtaking another vehicle. When overtaking and passing a truck or bus (and some cars), keep lights on low beam until your headlamps are abreast of the vehicle's outside rearview mirror to avoid blinding the driver. A quick flash of high beam is sometimes used in addition to the horn to indicate a pass. A driver should not flash a high beam until he is on the left side. Sometimes truck operators will flash various equipment lights as a signal to you. It is illegal to give a "do pass" signal in Texas.

When a vehicle in an overtake and pass goes by your car, lower your headlights to avoid blinding the other driver when he drives back to the right in front of you. The other driver should switch to high beam about the time you go to low beam (if he is not meeting a vehicle) to provide both you and himself with high beam seeing distance. You are required to keep your lights on low beam until he is over 300 feet from your car as he pulls away. While he is within 300 feet of you, your low beam and his car lights will provide your ample sight distance on road and shoulder.

f. **Watch** shoulder of highway for cyclists, pedestrians, or animals. A night driver must really concentrate over the traffic scene along and on the roadway. Failure to concentrate attention to compensate for poor visibility is one factor which causes an increase in the number of fatal accidents at dusk. This concentration increases fatigue, which in turn makes concentration more difficult. This is the penalty for night driving. Keep a constant lookout near and far, to the rear and to the sides. Keep your eyes moving. Practice this procedure until it becomes a habit.

g. Switch to low beam when you see a vehicle on a near side road turning onto the highway in your direction. Switch to low beam when you turn onto a highway from a side road if a meeting vehicle is near.

h. Keep ceiling lights of car off while driving. Keep panel lights dim for better vision, but always have enough panel light to read the speedometer. The speedometer is your best guide to safety when your senses are dulled by fatigue or have become insensitive to motion after driving awhile at rural speeds.

i. Always use the electric turn indicators at night, either with or without hand and arm signals. The electric signal can be given earlier more conveniently than can the hand and arm signal and can be seen farther. Keep broad side of hand toward drivers when you use hand and arm signals. An electric turn signal can always be seen by a driver immediately behind you but a distinct hand and arm signal can usually be seen by drivers behind this driver. Any turn, even changing position in a wide street without lane lines, requires a longer hand and arm signal at night.

j. Curves: On some curves a lower speed is necessary at night for the same degree of safety as in daytime. The more a road bends the more a driver's road vision is reduced. Unless speed is reduced when a driver sees the curve sign, he may find himself suddenly overdriving his headlights on a curve. In a right-turn curve he may not see a hazard on the right shoulder. Thousands of innocent victims have been killed because inept drivers waited until they were in curves before reducing speeds too fast for the curves. Reflectorized guides on curves, informational speed signs at curves, and your speedometer can make curve driving simple and safe. Keep to the right side of the centerline in a curve. The first law of the road is to keep to the right side. This rule does not pro-

hibit overtaking and passing on a slight bend where vision is not obstructed. It does prohibit driving on the left side of a two-way, two-lane road any time except when overtaking and passing legally or when the right lane is barricaded.

k. Hillcrests: When meeting a vehicle at a hillcrest and your lights are on low beam, the best way you can avoid a hazard in your lane just beyond the hillcrest is to reduce your speed before you top the hillcrest so you will not be overdriving your low beam after you top the hillcrest.

l. Before starting a pass at night, check ahead for road signs or markings that indicate traps such as curves, no-passing zones, and intersections.

m. When the headlights of a vehicle you are meeting are blended together, you will probably have time to overtake and pass a vehicle ahead. When the headlights become separate and distinct you may or may not have time to pass. A car with wide-gauge lights may be far enough away if it is going 55 mph and it may be too close if it is speeding at 70 mph. The distance to motorcycles and one-eyed cars is even more difficult to judge than is the distance to two-eyed cars. You should not have trouble, however, in distinguishing between a one-eyed car and a two-eyed car if you will recall how each appeared from a distance after it is close enough for you to tell.

n. Before applying brakes to slow down for a turn or stop in rural traffic, flash your stoplight at least three times to alert drivers behind you. At 55 mph it will take about 300 feet to give this prebraking warning.

o. If the headlights of a car following you are causing glare through the rearview mirror, tilt the mirror down just a little to reduce the glare.

p. It is easy for a driver on a strange highway at night to become confused at an intersection, especially a Y intersection, when he is not sure whether the highway marker he is following leads off to the right or left. This confusion can be especially hazardous on a four-lane road where the driver has to cross a traffic lane in order to correct an error. He should keep in mind that if he becomes confused, other drivers behind or alongside his car may also be confused as to the direction they should turn. The first precaution he should take is to slow down before he attempts any turning. If after slowing down he has gone too far to make a safe turn, he should continue on the incorrect route, make a U-turn later at a safe place, or if traffic is heavy circle a block to return to the intersection. He should not stop in the roadway to think or to back up in the roadway to get in position to turn if an overtaking vehicle will reach him before he is moving forward again. A driver should follow this "overtaking vehicle" rule when he is tempted to back at night on a rural road at any place for any reason.

5. Parking and Entering Traffic at Night on Rural Roads

a. If possible, select a parking place where there will be sight distances of 500 feet to the front and to the rear of your vehicle. Two meeting vehicles going 55 mph will reach your vehicle in 6 seconds. Each driver will have 300 feet to flash a stoplight warning to drivers behind him and 200 feet in which to slow down to 13 mph, with 50% braking, behind you.

b. Flash stoplight several times before you start braking if vehicles are behind you.

c. Park so that the left door of your car when opened will completely clear the pavement if it is at all possible. Four feet from a pavement may be four feet from eternity.

d. Leave low beam or parking lights on, but do not use high beam. Do not rely on parking lights unless they are bright and clean and visibility is good.

e. In case of car trouble, keep passengers in the car or between the car and the borrow ditch. Do not stand in front, at rear, or to the roadway side of a vehicle and do not let others do so if you are the owner or the driver. These are very dangerous places. Always carry a good flashlight. Flares also are valuable for use in an emergency.

f. Be sure headlights are turned on before pulling back onto the roadway. Use low beam if vehicles are meeting you on a two-lane road. Avoid entering traffic when a vehicle approaching in front is within 200 feet or if a fast vehicle approaching from behind is within 600 feet. If the left side of the road is not clear, a fast vehicle from behind should be 1200 feet away when you enter. Heavy opposing traffic may make it impractical to wait for a front clearance of 200 feet. Under such conditions do not angle toward the centerline or drive close to it during your entry. Do not enter while one car is overtaking another near your position, either ahead of or behind you. Accelerate quickly to normal cruising speed if vehicles are approaching from behind you.

g. If parking for a nap, lock doors and cut off engine, but leave parking lights burning. There is danger of carbon monoxide poisoning if you close up your car and leave the engine running. A small concentration can make you unconscious during a nap.

6. Dominant Factors That May Cause Nighttime Accidents

a. Fatigue is greater at night. Stop more often and stretch. Even a person in good condition should not drive over 100 miles without a rest stop. A smart driver will stop before he nods once, not after he has nodded and narrowly escaped death. A fatigue nod is just as dangerous as an alcohol nod. A 30-minute nap on the side of the road may add 30 years to your life. A short stop will help if you get fresh air and flex arm

and leg muscles by walking and stretching. Even though you may not be eye sleepy, your arm and leg muscles may "go to sleep" and fail to react normally. When this happens you will oversteer or understeer, and your foot pressure on the accelerator will be erratic. You are then a hazard to life and property. A sleepy driver, like a DWI driver, cannot control his car. One will kill as dead as the other. One is as responsible for an accident as the other.

The DWI driver may give you a little more warning by his erratic driving than does the driver who passes out with fatigue and suddenly comes cutting across the centerline head-on into your car. Think it over when you are blinky-eyed and keep trying to drive. You may be able to save the lives of an innocent family coming your way (if you don't value your own) by stopping while you still have enough good judgment left to stop. Fatigue, like alcohol, is an enemy of good judgment.

b. Speed is more hazardous at nighttime than in daytime because:

(1) Reduced road visibility prevents drivers from seeing hazards that would be obvious in daytime.

(2) It has been longer since most drivers have slept and the resulting fatigue increases perception-reaction time.

(3) More drinking drivers will be met.

(4) It is easier for drivers to become confused in traffic and to panic.

These factors in varying degrees coupled with high speed cause accidents that would not occur in daytime.

c. Drinking and driving is more hazardous at nighttime than in daytime:

(1) Alcohol is an anesthetic and therefore increases drowsiness which is more prevalent at night.

(2) Alcohol makes a driver overconfident at a time when he is faced with traffic hazards which call for more caution.

(3) Alcohol impairs judgment, reduces visual acuity already reduced by darkness, increases perception time and reaction time, and hampers muscle-mind coordination. The last three become special hazards at night after a driver becomes confused in traffic due to other night hazards.

7. Speed and Night Vision

a. Every driver is aware of the headlight glare problem, but many do not recognize when they are driving too fast for their seeing distance, because they do not know about stopping distances. When the intensity of a headlight is increased or the beam is raised in order to see farther ahead, the resulting glare reduces the seeing distance for meeting drivers. The present headlight regulations are a compromise.

When meeting drivers going 40 mph on high beam are 3,000 feet apart on a level, two-way road, the visibility distance is 40% less than on a clear road, according to General Electric tests made with man-size dummies in dark clothing placed 2 feet inside the driver's lane on the right-hand side. The visibility distance continues to decrease slightly until the drivers pass each other. When the drivers are about 1,000 feet apart they can see as well on low beams as they can on high beams. If the drivers go to low beam when they are over 1200 feet apart, the seeing distance drops below the stopping distance at legal speeds. Futhermore, during the last 200 feet before meeting (with low beams) the seeing distance drops below the stopping distance. (While on low beam, meeting a low beam, some drivers can detect the silhouette of an obstacle better than others and their seeing distance is therefore longer.)

In the General Electric tests, the drivers (with 20/20 vision) going 40 mph were expecting the obstacles and could detect them with high beam on a clear road at 500 feet. When drivers are not looking for an obstacle known to be ahead, the attention factor is 0.5. That is, they would detect the obstacle only half as far away, or at 250 feet.

These results point up the value of mind and eye attention to the roadway. In fact, it is believed that the attention factor may be about 0.75 when drivers meet vehicles, due to the concentration of attention to the roadway. This fact may keep the seeing distance of some drivers above the stopping distance when they are meeting vehicles. The drivers in the tests, expecting the obstacles, could see about 200 feet when their vehicles (on low beams) were 100 feet apart.

A driver not expecting an obstacle but with an attention factor of 0.75 could see 150 feet. With a reaction time of 0.75 second and a braking effort of 60% a driver going 55 mph would have a stopping distance of 228 feet. At 45 mph his stopping distance would be 162 feet. If a driver's attention factor were 0.9, he would see 180 feet and might be able to make an emergency stop at 48 mph within that distance. It is obvious that most drivers would be overdriving low beam headlights at a speed of 55 mph when meeting a vehicle on low beam.

b. With an attention factor of 0.5 on a clear road a driver at 40 mph would detect an unexpected dark obstacle at a distance of 250 feet. However, this seeing distance will decrease about 2 feet for each mph increase in speed. At 55 mph the seeing distance would be 220 feet. The stopping distance would be 228 feet. It is apparent that a driver not giving better than average attention to the roadway would be overdriving his

high beam headlights at 55 mph on a clear road. The lag in perceiving a hazard becomes a factor that partly determines whether or not 55 mph at night is a safe speed.

A braking effort of 60% is severe and may result in loss of directional control of a vehicle. It may be the maximum braking effort a driver can apply on some pavements even if he locks his wheels. The instructor may prefer to substitute 50% braking in the preceding examples.

c. There is an additional factor that causes collisions even when a driver is not actually overdriving his headlights. It is the tendency of the average driver to delay reducing his speed enough immediately upon seeing an obstacle in or near the roadway. Often a driver will only release the accelerator when he should be applying his brakes. Too late he finds that locking his brakes will not prevent a collision. A driver moving at a smooth constant speed for several miles ceases to be conscious of fast motion. The daytime cues are missing. A slight deceleration gives him a deceptive feeling of being able to stop quickly.

Add the distance for a delay of 3 seconds to reaction time distance and braking distance and you will discover how delay increases a driver's stopping distance at 55 mph, even if he could lock all brakes. Three seconds at 80.7 ft/sec adds 242 feet to his stopping distance.

d. A driver traveling 55 mph at night may have to make a locked wheel stop when confronted by an unexpected dark obstacle in order to stop short of the object. Locked wheel stops at 55 mph and above are very hazardous. Most drivers are overdriving their headlights above 55 mph. If one is prodded by fear to lock his brakes at high speeds, he may "freeze" and let his car go out of control and overturn, even if he misses the obstacle. A few seconds of panic in emergencies have caused many serious accidents which the drivers might have avoided had they been conditioned through proper training to maintain steering control. It is safer to hit small animals or fowls in an emergency stop than to jerk the wheel to one side and freeze on the brakes at 55 mph. When there is opposing traffic a driver should constantly observe the shoulder for escape passages, in case his lane should suddenly become obstructed. He must avoid entering the other lane in front of close approaching vehicles at all costs. He should condition his thinking to the fact that he should leave the roadway and decelerate on the shoulder or in the borrow ditch, rather than hit a vehicle or a fixed object. A driver's responsibility starts with the speed he is traveling. He must not overdrive his headlights, collide with a vehicle in the other lane to avoid a hazard in his lane, and then say, "What else could I do?" as an out.

e. Speeding drivers traveling speeds such as 70 mph at nighttime require a distance of 404 feet for an emergency stop, with 0.75 second reaction time and 50% braking effort. These drivers are continually being involved in night accidents such as:

(1) Running into the rear end of slow vehicle just beyond a hillcrest.

(2) Running into the rear end of slow vehicles with or without taillights, such as farm tractors, wagons, or slow trucks, on level roads.

(3) Running into unlighted vehicles parked on the roadway.

(4) Running over road detour barricades.

(5) Running down pedestrians in dark clothes walking along edge of pavement.

(6) Running off roadway on curves.

(7) Running into embankments at T-intersections.

(8) Running into freight cars at nonsignalized railroad crossings.

(9) Running into vehicles wrecked on the roadway.

(10) Running into animals in roadway.

f. The following series of accidents illustrates the prevalence of blind driving and provides classic proof that many drivers do not compensate for abnormal driving conditions:

On the night of March 29, 1939, in po[illegible] rain, twelve cars plunged off the end of a washed-out bridge over Clear Creek Bayou, located near Vicksburg, Mississippi. Darkness and rain combined to limit a driver's field of vision, yet a careful driver operating his car within the range of his headlights and compensating for wet pavement would have been able to stop before going off the end of the bridge. The fact that twelve cars plunged into the swollen bayou before one driver on the highway was able to stop his car in time to prevent it from taking the plunge is strong evidence that most drivers overdrive their headlights. Due to this dangerous practice, 16 people lost their lives in this one tradegy.

g. Overdriving headlights:

Overdriving headlights is driving at a rate of speed which during an emergency stop would force the car to travel beyond the point at which the car's headlights enable the driver to detect a dark object or a person in dark clothes. A safe driver must recognize that the safe rate of speed may frequently be under the legal limit.

The top speed at which a driver in a given car will not be overdriving his headlights varies with the driver's physical condition, the colors of the pavement and shoulder, the friction value of the pavement, and atmospheric conditions. This top safe speed is highest when a car's headlights and brakes are in A-1 condition, the driver has fast glare recovery and is fresh and alert, the pavement and shoulders are light colored, the atmosphere is clear, and the value of the coefficient of friction of the pavement is high.

If a driver knows the farthest distance his headlights make a dark object visible to him under normal conditions of road and weather, and also knows the top speed at which he can react and stop his car safely in his traffic lane within this distance, he can determine the top safe speed at which he will not be overdriving his headlights under normal conditions. In order to compensate by lowering his speed under adverse conditions he should know approximately how much rain or mist reduces his visibility and how much his top speed must be reduced to keep his stopping distance within his seeing distance.

Intuition is not a good guide in this driving problem, because a reduction of 5 mph from 55 mph provides more margin than the 5 mph would indicate. For the same reason 5 mph added to his top safe speed might result in his overdriving his headlights as much as 40 feet. A person who speeds at night does not have as many drivers taking care of him as by day, because the other drivers cannot tell he is speeding until it is too late for them to compensate for his errors. A speeder, day or night, who defends his ability to drive at high speeds should ask himself why he has any right to expect the other owners of the highway to clear the way for him.

h. Excerpt from a newspaper article reporting the death of a Texas pedestrian:

"John _____ was killed instantly when he was struck by a car about 7:20 p.m. The driver stated he was traveling west...and the pedestrian was walking east approximately three feet on the pavement...when the car hit him with the right front fender. The driver was meeting a truck...and both drivers had their lights on dim. Neither driver saw the pedestrian, because of his dark clothing, they told officers."

i. Excerpt from a newspaper article reporting three deaths in one Texas family in a night accident:

"A car driven by _____ hit a highway shoulder, flipped over and caused three deaths last night. Police said _____ was blinded by the lights of a passing car."

WINTER DRIVING

1. Two major physical problems which are common to winter driving are (1) reduced visibility and (2) reduced traction. When both factors are present a driver faces hazards unequaled under any other driving conditions. When visibility is reduced he needs better traction to compensate for delayed seeing but he has less. When traction is reduced he needs to see hazards earlier to compensate for longer braking distances but he sees them later.

2. Visibility is reduced in the following ways:

a. Fog, sleet, or ice on car glass, including car lights and outside mirrors, makes the glass opaque.

b. Fog, sleet, or snow in line of vision delays a driver's awareness of other vehicles and of pedestrians.

c. Snow banks and snow on trees or shrubs at intersections block vision.

d. Fog, sleet, or ice on glass of other vehicles prevents seeing through the vehicles to detect hazards beyond.

e. Snow covered vehicles, parked or moving, are camouflaged against the background and may not be seen in time.

f. Snow covered road signs are less obvious even though the shapes of signs should alert drivers to hazards.

3. Friction between a car's tires and ice or packed snow is extremely low as compared with the friction between tires and dry, or even wet, pavement. The lower the friction constant, the more difficult it is to maintain traction in starting, turning, backing, accelerating or cruising. Traction is the force which the road surface can exert against the tires to keep them from slipping. When the engine turns the drive axle, traction holds the contact point of each rear tire still against the road surface. This anchoring of the bottom of each rear tire forces the hubs of the wheels forward and the car moves. Traction also prevents the front tires from slipping when the front wheels are turned from straight ahead.

The coefficient of friction between rubber and packed snow may be only ¼ of what it is between rubber and good dry pavement. Between rubber and clear ice it may be only 1/8 as great as between rubber and good dry pavement.

4. Controlling a car on ice or packed snow is mainly a problem of controlling **velocity** and **acceleration**, which can be either positive (increasing speed) or negative (decreasing speed). The later also is called deceleration.

a. Velocity involves both **speed** and direction (turning).

(1) The speed (rate of travel) determines the distance covered during linear acceleration or deceleration.

(2) A change in direction (turning) causes a side force to act against the center of mass of the car.

b. Acceleration is the rate of changing the **speed** and/or the rate of changing the **direction** of the car's velocity.

(1) Linear acceleration is the rate at which the straight ahead speed is changing. The lower the road friction, the lower this rate must be.

(2) Angular acceleration includes the rate at which the car's longitudinal (fore and aft) axis changes direction from "straight ahead" as the car at a given speed is turned into paths of successively shortening radii, i.e., abrupt or quick turning movements of the front wheels while the car is in motion. The lower the road friction, the lower this rate must be (i.e., a turn must be made more slowly for a given speed).

c. Linear acceleration and angular acceleration rates are limited by the friction exerted between the tires and the ice surface.

(1) The job of driving safely on ice is difficult because a driver must keep these acceleration rates low enough that tire traction on the ice is not lost. When traction is lost slippage occurs. As slippage increases the loss of control of the car increases.

(2) Neither the power of the engine (for ease in increasing speed), the power of the brakes (for ease in decreasing speed), nor the steering gear ratio (for ease in turning) is designed for operating a car on an ice surface. These facts and the pressures a driver normally exerts on controls make it difficult for a driver to apply the extremely light pressures required to maintain traction on ice.

5. Things one can do to increase visibility for himself and for others:

a. Keep car glass clear of ice or snow with a good defroster, good wipers, and/or scrapers which will not scratch the glass. Commercial preparations may help. A block of wood with square edges makes a good scraper.

b. Remove snow from car so that the car's color (if not white) will form a contrast with the background. If your car is white keep in mind that it is less likely to be seen than a black or colored car.

c. Know that all car lights will burn and use them when it is snowing or sleeting. Try both high and low beam to find which will aid you more, keeping in mind low beams are required when meeting or following other vehicles.

d. Increase following distances so that you can "see around" vehicles you cannot see through and to escape snow spray or slush thrown up by the vehicle ahead. After a windshield is sprayed you may have difficulty seeing well enough to get stopped in a safe place. You may be able to see a little better by moving your head closer to the windshield.

6. Equipment and its maintenance which will increase or maintain tire traction on ice or packed snow:

a. Keep brakes equalized so that use of brakes will not cause wheels to pull sideways and lose traction. Grease on one front brake lining may cause a car to spin when brakes are applied on ice.

b. Keep wheels properly aligned so that as they revolve they will not move sideways and lose traction.

c. Keep tires inflated to pressures recommended by manufacturers. Letting air out of tires to increase area of tread contact with ice or packed snow may decrease braking distances slightly, but it may cause difficulty in steering control on curves and it surely will increase tire heat and hasten wear.

d. Special winter tires may increase traction on ice or packed snow, but their slight advantage can be quickly offset by a driver's overconfidence, unless he drives with the same precautions necessary with normal tires.

e. Reinforced tire chains (each link of the cross-chains is reinforced by projecting teeth or cleats) are much more effective in maintaining traction than are special winter tires.

f. Regular tire chains, like reinforced chains, increase traction during acceleration and deceleration, but National Safety Council tests show that they are less effective than reinforced chains in resisting side skids on ice, which are hazards in turning.

7. In starting on ice or packed snow use the highest gear and lightest gas pedal pressure that will move the car slowly and smoothly. If one wheel spins, cram a newspaper under the front of the wheel to help overcome starting inertia. Keeping front wheels straight or turned toward lower ground will help overcome starting inertia.

8. Immediately after starting for the first time under conditions of snow and/or ice, apply the brake pedal lightly, then the gas pedal lightly to get a feel of the pressures which will cause the tires to lose traction. Make these checks in a level area free of traffic. Then remember that a gas pedal pressure safe on level

ground may cause the rear wheels to spin on an upgrade and that a brake pedal pressure safe on level ground may cause the front wheels to skid on a downgrade. (Front brakes may lock ahead of rear brakes.)

9. Avoid ground areas that slope sideways (especially in turns) to prevent gravity (and/or centrifugal force) from pulling either the front end or the rear end of the car into a curb, gutter, or ditch.

10. Once a car is moving at a constant low speed on level ice, inertia tends to keep it moving. Very little engine power is needed to overcome wind, chassis, and rolling frictions as compared with the power needed at normal cruising speeds on dry pavements. This fact and normal driving habits get drivers in trouble. Unless a driver concentrates on the foot pressures he is using, he will inadvertently overaccelerate and lose traction. For example, the use of normal pressures on steering wheel and gas pedal while overtaking and passing can easily cause the driver to skid his car into the other vehicle.

11. Overbraking usually is forced upon a driver who delays deceleration when approching a hazard or a place where he must or intends to change direction. A driver should condition himself to ease off on the gas pedal early and let the engine do most of the braking. The engine can brake a car more smoothly than can a driver, but it needs a much longer distance than a driver normally uses.

12. In following another vehicle on dry pavement you must consider mainly your **perception time distance** and your **reaction time distance.** In following another vehicle in fog you must also consider **braking distance** because the driver ahead of you may stop abruptly upon striking an animal or a vehicle which was not moving (or was moving very slowly) when the driver first saw the animal or stalled vehicle. In following another vehicle on ice you must consider all three distances just as you must in fog although the braking distance is a factor for a different reason. In fog the braking distance may be a factor because a hazard may not be seen early enough. On ice the braking distance is always a factor, even though the hazard is seen early, because the maximum braking effort that can be exerted is always very low. This fact makes braking distance a prime hazard factor on ice.

13. On a very good dry pavement, a driver with good brakes can vary his braking effort from say 80% down to 0%. On ice and hard packed snow the braking effort he can apply may range only from 20% down to 0%. At 20 mph an 80% braking effort (good dry pavement) stops a car in 17 feet. At 20 mph a 20% braking effort (packed snow) stops the car in 67 feet.

Note the effects of temperature on braking effort on ice (NSC tests):

Data from tests on glare ice of 0°F give an average braking distance of 125 feet at 20 mph. This is a braking effort of 10.7%.

Data from tests on glare ice at 20°F give an average braking distance of 195 feet at 20 mph. This is a braking effort of 6.8%.

Data from tests on smooth ice at 32°F give an average braking distance of about 220 feet at 20 mph. This is a braking effort of 6%.

$$BE = \frac{(MPH)^2}{30\ BD}$$

BE is braking effort
The "30" is a constant
BD is braking distance (ft)

We see that the braking distance at 20 mph increases from 17 feet on good dry pavement to 220 feet on smooth ice when the temperature is 32°F.

14. In approaching the crest of an icy hill try to maintain just enough momentum to reach the top and then let off gradually on the gas pedal so your engine will start holding your car back on the downgrade. If either the upgrade or the following downgrade is steep enough for a lower gear, make the shift smoothly before the momentum dies off going up or before it increases going down. If the momentum gets too low going upgrade, more power may be needed to complete the climb than friction between the tires and ice or packed snow can stand. Your car would then stall with rear wheels spinning. The momentum on a downgrade can quickly get so high that even locked brakes could not reduce your speed. Your car would then be out of control.

15. On a steep downgrade the gravity pull alone may exceed the retarding force of the road's low friction. You could not then stop the car on the grade from any speed no matter how low. In such a case you should start downgrade in low gear, keep foot off gas pedal, and pump brake pedal rapidly so as to reach the bottom of the grade at as low a speed as possible.

16. National Safety Council tests show that a car's braking distance on glare ice can be reduced considerably by pumping the brakes so that they are alternately applied and completely released. The technique consists of a series of very rapid brake applications, during which the brakes are fully applied for an instant and completely released for an instant. On packed snow the technique recommended is to apply the brakes gently until you feel that the wheels are starting to slide and then release them slightly. If this procedure does not get results, you should start the pumping action at once.

17. Keep in mind that a wheel sliding on ice cannot be steered. You must keep it rolling over the road surface to maintain traction, which can create a steering force. In fact you must have traction at the front tires to steer a car and you must have traction at the rear tires to make it move. When you spin a rear wheel in trying to start up, the relative speed between the drive tire and the ground, at the tire-ground contact point, must be zero or the car will not move. No matter how fast a car travels, the velocity of that part of a tire touching the ground must be zero or there is no trac-

tion. When the relative speed between a front tire and the ground, at the tire-ground contact point, is not zero, the road surface is not exerting enough force against the tire to change the car's direction.

18. A treacherous trap during icy weather is a stretch of roadway where ice has not melted during thawing temperatures. You may expect such spots in areas shaded by buildings, trees, hills, or underpass structures, and should reduce your speed sharply before reaching them and hold a constant speed while crossing them. When the temperature drops near freezing, every bridge or overpass you approach should suggest "ice" which may form on a bridge or overpass before it forms on the ground roadway and which may remain after ice on the ground roadway has melted. Bridge ice has caused the death of many careful drivers and their passengers.

19. In the first paragraph, reduced visibility and reduced traction are listed as two major physical problems in winter driving. The paragraphs that follow contain analyses of these two major physical problems. The broad objective is to convince the driver that he must consciously supplant his normal driving habits with a new set of slow motion habits while operating a car on packed snow or ice. His task is comparable to that of a demolition expert working on a dud bomb. The term "easy does it" applies in the handling of all car controls except one—fast pumping of the brake pedal to shorten the braking distance. Otherwise all movements of controls should be slow and deliberate.

The big job is to prevent spinning, slipping, or skidding of tires. This cannot be done completely. Sometimes a little spinning of rear tires will, through an invisible series of "sticks and slips," develop enough traction to overcome inertia of a car at rest. When your car is cruising at a constant speed on ice, the rear wheels will be turning a little faster than the front wheels due to unavoidable slippage. On most turns the front tires will slip sideways a little. On a roadway which slopes sideways all tires may slip to one side a little. In short a car in motion on ice more or less "floats" along. The driver must sort of coax it in a gentle manner and give it plenty of time to react in order to get it to do what he wants it to do. Even normal recovery from side skids—turning in the direction of the skid—should be done with slow and gentle pressures on both the steering wheel and the gas pedal.

20. National Safety Council tests:

Tests show that at 20 mph, on smooth ice, with conventional tires:

When the air temperature is 32°F,
Average Braking Distance is about ..... 220 feet

When the air temperature is 0°F,
Average Braking Distance is about ..... 125 feet

These tests show the need for a driver to "get the feel of the road" by testing the effectiveness of his brakes as freezing temperatures rise from low levels.

On Glare Ice at 20°F:
Regular Tires ..... 195 feet
Snow Tires ..... 174 feet
Regular Tire Chains ..... 99 feet
Reinforced Tire Chains ..... 77 feet

On Hard-Packed Snow (20 mph):
Conventional Tires ..... 62 feet
Winterized Tires ..... 52 feet
Mud-Snow Tires ..... 54 feet
Winterized Mud-Snow Tires ..... 51 feet
Tire Chains ..... 38 feet

On Dry Concrete (20 mph):
Conventional Tires ..... 21 feet

(The braking distance of 21 feet on dry concrete is equivalent to a braking effort of 63.5% or a pavement friction value of 0.635.)*

* A car braking on packed snow or ice, of course, cannot meet the minimum braking effort required by law, which is stated as being 45% on page 60 under the subject, Driving on Slick Roads. The law actually requires that a car's brakes be able to stop the car within 30 feet from a speed of 20 mph on a "dry, smooth, level road free from loose materials." The following formula translates the braking distance into braking effort:

$$\text{Braking Effort} = \frac{(\text{MPH})}{30 \times \text{braking distance}} = \frac{20}{30 \times 30} = \frac{400}{900} = .444 = 44.4\%$$

The constant "30" in the formula results from rounding off a number slightly less than 30, which would make the effort between 44.4 and 45%. Sometimes 44.5% or 45% is used.

DRIVING ON MOUNTAIN ROADS

1. Before Starting a Trip through Mountains, Check Vehicle and Equipment.

a. Gasoline: See that your supply will carry you to the next service station. An engine will use more fuel on a road that has up and down grades than on a road that is level.

b. Oil: An engine will use more oil on hills. It may be advisable to carry an extra supply.

c. Water: An engine will get hotter on grades and water will boil at lower temperatures as altitude increases. An extra supply may be carried in a water bag.

d. Tires: Check five tires for prescribed inflation. See that you have tools and a jack for changing tires and that the jack will work.

e. Windshield Wiper: See that the wiper works properly and that blades are in good condition.

f. Lights: Check all lights, even for day trips. Carry a good flashlight and at night keep it where it can be reached quickly.

g. Brakes: Most important. Have brake system checked by a mechanic. The brake law requires that a parking brake be able to hold a car (parked) on any hill over which it is driven.

h. Engine: If an engine runs rough, it will overheat, use more gas and lose power.

i. Load: An automobile with five occupants and a loaded trunk compartment increases passing distance, increases braking hazard downgrade, impairs directional control on curves, and for safety requires a slower cruising speed and more advance planning. A trailer makes braking much more difficult and passing more hazardous. Locate heavy weights as far forward as possible, including passengers in the car and baggage in the trunk.

j. Chock-Blocks: A block of wood, 4 x 4 x 6 inches, may be useful when it is necessary to park on a steep grade. Keep block within ready reach. Chock a front wheel if a car is headed downgrade and the rear wheel if headed upgrade. Sawing the block in two along a long diagonal will make two triangular blocks for two wheels. A small sack of coarse sand can be used as a chock block and the sand can be sprinkled in front of the rear wheels to get traction in starting a car stalled on snow or ice on an upgrade.

k. Snow Chains: If it appears chains may be needed, always obtain local advice before entering mountains.

2. The Steepness of Grades in Mountains is Often Deceptive

a. Soil layers in hill cuts and angles of slopes of surrounding peaks often make a road appear to slope in one direction when it really slopes in the other, or make a grade appear less steep than it really is. An engine may appear to be laboring unnecessarily when the labor or overheating is being caused by a hard pull on a grade that is steeper than it appears.

b. This grade deception may also cause a driver to let a car accelerate out of control downhill unless he checks his speedometer frequently.

3. Use of Proper Gear

a. The horsepower of an engine decreases with altitude. At one mile altitude an engine loses about 20% of its sea level horsepower. This loss decreases the rate of acceleration in passing and requires use of a lower gear on a steep grade earlier than a driver would expect to use it on a similar grade at low altitude.

b. An experienced driver can tell by the sound of his engine when he should shift to second gear. A fair guide for shifting when the engine is pulling a grade is when the speed falls below 17 mph. A shift should be made when the speed is the rate at which the engine can be driven in second gear for some distance. This rate is just fast enough to permit the engine to run smoothly. The lower the rpm of the engine, the longer it will run in second gear (or low gear) without overheating. Fair speeds for long pulls: second gear—15 to 17 mph; low gear—5 to 7 mph.

c. Just before an engine stalls and when the car is **barely creeping** in second gear, an experienced driver can either double clutch or make a quick direct shift to low gear. If a driver cannot do either, he should stop, set the hand brake, shift to low gear, and make a normal start, except he should give more gas than in normal starting and release the hand brake slowly as he engages the clutch. When possible keep your car going in second gear even if you have to speed up to climb an extra steep section of grade along the hill.

d. When approaching a steep downgrade, especially one involving turns, you should shift to second gear (low gear if grade is very steep) if it appears you will have to use brakes constantly to hold your speed to 30 mph. Shift an automatic transmission into "low drive." Take your car out of overdrive on a hill that is not steep enough for second gear.

If shifting is delayed and speed increases too much for a direct shift to second gear, an experienced driver can double clutch to get into second gear:

Push in clutch pedal
Release gas pedal
Shift into neutral
Let out clutch pedal
Accelerate engine (the faster a car is moving the more gas you give)
Push in clutch pedal again
Shift into second gear
Let out clutch pedal
Pump brakes as needed

In second gear the engine will slow the car and less braking will be needed to maintain a safe speed.

e. Do not coast a car on hills. With your car in gear and clutch engaged you have better control of speed and steering.

f. Highway signs will aid you in selecting gears, but keep alert to the road ahead because signs may not always be posted.

4. **Brake Hazards on Mountain Roads**

a. Constant braking down long grades will cause brake drums and brake linings to become very hot. When heated, the brake lining materials give off a lubricant on the brake lining surface. At the same time the heat may cause the drums to expand away from the brake shoes. When these things happen you have fadeout brakes. Hard pushing on the pedal will have no effect.

b. Tests conducted by Lasco Brake Products Corporation show that when the drums and lining begin to cool after a fadeout the brakes again become effective. However, as the brakes cool (following a fadeout) a secondary "soaping" of the linings may occur and the brakes may temporarily fade out again. This is called secondary fade. A hard but ineffective brake pedal may result.

c. Some brake linings will fade with less heat than others, but the manufacturer says that all of them will fade if you get the drums and linings hot enough. And you can get them hot enough on mountain roads by going down long grades in high with your brakes on all of the time. This heat may also cause a vapor lock in the brake fluid. A soft pedal will result.

d. If you fail to release your hand brake properly, not only will the hand brake lining fade (on level roads) but the heat generated may cause a vapor lock in the brake fluid, resulting in a soft pedal.

5. **Protecting Your Brakes and Yourself on Mountain Grades**

a. The first precaution is not to plan a mountain trip with an overloaded car. Your car's brakes may not be designed for 6 big adults and 6 heavy bags.

b. Shift to second gear, or low gear when necessary, so that the engine will help keep your speed under control.

c. Pump the brakes intermittently as hazards ahead demand. If you see that a grade on a straight stretch flattens out for a distance down the road, you can afford to let your speed increase temporarily, whereas a bend in the road ahead would require braking.

d. Keep alert to a change in the feel of pressure against your brake pedal. If your brakes start failing, stop and let them cool. If your foot brakes go out in high gear, shift to second gear and work the hand brake to control speed. If it appears you cannot stop, double clutch to low gear. If you cannot stop in low gear but can control your speed, ease off on the hand brake whenever it is safe in order to cool the hand brake linings.

If a long winding downgrade is ahead and you are unable to slow your car in any way, it may be advisable to sideswipe an embankment or run into brush before your speed builds up. Another driver may detect your trouble and maneuver to get in front of your car to slow you down. Be alert to such an "angel" and do not try to dodge him. He will adjust his speed so as to reduce the impact on contact. If he is ahead of you already, your horn blasts may alert him to answer your prayers.

6. **Use of Horn:** Use the horn to alert other drivers that you are coming when you are on winding roads where sight distances are short (200 feet or less) and be alert to horns yourself.

7. **Keep to Right:** Keep well to the right side of the roadway at turns, curves, and hillcrests. Give way to a fast vehicle coming toward you downhill on a curve. It may be out of control and forced to use a part of your side of the roadway.

8. **Following:** The extra distance required to stop a car downhill, the danger of rollback of a stalled car on a steep upgrade and the lack of shoulders on which to escape make it important that a driver allow more following distance on mountain roads than the minimum needed on level roads. At 15 mph upgrade, follow at a distance of at least 50 feet. At 30 mph downgrade, keep at least 100 feet between your car and the vehicle ahead. Increase this distance behind a truck downgrade. You may outbrake a truck on level roads but a truck's gears and brakes may enable the truck operator to control his speed better than you can an overloaded passenger car down steep grades.

9. **Overtaking:** The hazard of overtaking and passing another vehicle on an upgrade is greater because (1) the upgrade and loss of engine power due to altitude lengthen the time your car is on the left side of the road and (2) the downgrade which the driver you are meeting is on lengthens the braking distance of his car. On an upgrade it may be advisable to shift to second gear to overtake a slow moving vehicle. Blind passes (short sight distances)

on a winding road upgrade are very hazardous. It is wise to give way as a car starts to overtake and pass your car and to reduce your speed as the car comes alongside your car. If there is a pullout for slow vehicles to use in letting faster cars go by, use it.

10. Mountain Snow: Patches of snow or ice may create surprise hazards. Ease off on the accelerator (or the brakes) just before crossing them.

11. Parking Precautions

a. Make only emergency stops along winding roads. Ordinary stops should be made where two drivers approaching you from opposite directions can see your vehicle and each other at the same time. Even for a flat tire do not stop near a blind turn if you will have to work on the edge of the roadway. If the turn is to the left, the danger will be greater, because centrifugal force will push cars your way.

b. Stops should be made on the right side of a roadway unless the right shoulder is too narrow and there is a wider, safer parking area on the left side. If you cannot safely make a U-turn and you have to park on the left side at night, get as far from the roadway as possible, angle the front of your car away from the roadway slightly, and turn on parking lights. When parked on the right side, use parking lights or low beam. Always use low beam if visibility is poor.

c. See parking under Rural Driving for additional suggestions.

12. Mountain Chauffeur: Before starting through mountains a driver might well inquire locally about normal or special road hazards ahead. Inexperienced drivers sometimes employ chauffeurs to drive for them through hazardous areas. This investment will permit a driver to enjoy the scenery and may reduce the likelihood of his passengers' developing stomach ulcers or wearing out the floor mat pressing an imaginary brake. An inexperienced driver should never attempt night driving on mountain roads.

DRIVING ON FREEWAYS

1. Characteristics of a Freeway

a. A freeway is a road that does not have crossroad intersections. It may consist of two, three, or four traffic lanes moving traffic in each direction. Opposing traffic is separated by a grass plat, a curbed dividing strip, or other physical barrier. A freeway may have a right-side curb which a vehicle can cross safely at low speeds in order to drive onto the shoulder.

b. A freeway may have frontage or service roads running parallel to it from which traffic enters the freeway and onto which traffic moves when leaving the freeway. The service roads usually carry one-way traffic but some sections may be signed for two-way traffic. Ramps connecting the service roads and the freeway compel traffic to enter and leave the freeway at an angle that permits drivers to look back for approaching vehicles so that if the way is clear they may proceed without having to stop. The angle of the exit and entrance ramps serves to reduce the severity of a collision, should one occur, because the colliding vehicles will be going in the same general direction. This approach angle reduces the relative speed of two vehicles.

c. A driver on an entrance ramp to a freeway must yield to traffic on the freeway. The driver of a vehicle proceeding on an access or feeder road of a controlled access freeway shall yield the right-of-way to a vehicle entering or about to enter the access road from an exit ramp or is leaving or about to leave the access road to an entrance ramp to enter the freeway. As a driver enters an access road he should look for a lane sign or a pavement marking such as a double center stripe which may limit his movements on the access road for some distance. The purpose of the yield sign is to blend two streams of traffic at a point of conflict. The blending traffic must select a speed that will make blending safe or wait until it can blend from a stop.

d. Roads crossing the freeway will pass over or under the freeway. An intersection where crossing conflicts are eliminated by overpass or underpass structures is called a grade separated intersection or interchange.

e. A driver on a freeway usually must make a right turn off the freeway to start a maneuver for either a left turn or a U-turn. A driver going south on a freeway, wishing to go north, must leave the freeway on the right, enter the service road, proceed to a grade separation, pass over or under the freeway, turn left on the other service road, and drive to the first freeway entrance headed north. However, other types of interchanges (grade separation structures and ramps) exist which may require considerably different procedures. Some designs of direct interchange-type may require left turns to be made from the left lane. A driver should be alert to posted instructions which will inform him well in advance of such a turn-off.

f. A freeway may have both maximum and minimum speed limits posted.

g. A freeway may have special instructions posted such as Slow Traffic Keep Right. These special instructions are the law on a freeway. However, a minimum speed limit would not apply if conditions should make the minimum posted limit an unsafe speed.

h. Destination signs posted well in advance of exits give the names of highway routes or streets located just beyond the exits. The names of the routes or streets are also posted at the exits proper. When you approach an exit which has a deceleration lane, get into the deceleration lane to slow down for your exit turn. Do not turn directly from the cruising lane into the exit ramp.

i. The outside lane of a freeway is usually considered the slow lane because vehicles entering and leaving the freeway will be accelerating or decelerating in the outside lane. Some freeways may have a special short deceleration lane into which vehicles can move to approach an exit and a special acceleration lane at entrances which vehicles can enter while waiting for an opening to enter traffic in the outside lane. A left turn deceleration lane may be on the left side of the inside lane in rare designs where left turns off a freeway are made from the left lane. Such an exit usually will lead to a pass over or under opposing traffic.

j. Service roads also may have a short deceleration lane preceding an entrance ramp and a short acceleration lane beyond an exit ramp of a freeway.

2. To enter a freeway you must slow down in the left lane of the service road, give a left turn signal, and while you are on the ramp look back out of the driver's window to check traffic in the outside lane of the freeway. If the outside lane is clear, you may enter the freeway and accelerate in the outside lane or in the acceleration lane if one is available. (If the service road is two-way, you will have to approach an entrance ramp on the right side of the service road and make a normal left turn into the entrance ramp.) If the outside freeway lane is not clear, you should wait until a gap in traffic sufficiently long for you to enter becomes available. The yield sign law says a driver shall "slow down to a speed reasonable for existing conditions." If no freeway traffic is near the legal entrance speed could be higher than if traffic were approaching within a few hundred feet.

3. Look for lane instructions posted on the freeway. If there are none, you may cruise in any lane, provided you maintain a speed within the posted limits. If you cannot or do not wish to drive at or above minimum speed limits you should stay off freeways.

4. Ordinarily you should select a lane that meets your need yet does not congest traffic, unless special instructions are posted. If you wish to drive at the minimum limit, or if you intend to be on the freeway only a short distance, stay in the outside lane. If you wish to travel at the maximum rate allowed, get into the middle lane (if there is one) or the inside lane. The middle lane is better if you plan to leave the freeway soon, because you will have less trouble changing to the outside lane when you approach your exit. If you wish to drive at the maximum rate allowed and you will be on the freeway for a considerable distance, you will cause less congestion and be less exposed to hazards by driving in the inside lane. When you near your exit, you should maneuver to the outside lane. The heavier the traffic, the earlier you should start maneuvering to the outside lane. These are general guides, of course, and are subject first to lane instructions, then to lane loads, other vehicle speeds, and the amount of lane changing that is taking place.

5. If you have car trouble, or have to stop for any other reason, signal a right or left turn, depending on the lane you are in, and start maneuvering as soon as you can do so safely to get onto a shoulder. If traffic permits, go to the right shoulder. In some areas there will be no other place to go. A rural freeway may have a "shoulder" to the left of the inside lane, which you might use in an emergency. (You should not make a routine stop on a divider strip unless there is a shoulder.) If your engine is about to stall in one of the few areas where there is no shoulder, maneuver to the slow outside lane. If you have a flat, keep driving until you reach a shoulder. If you are in the outside lane and wish to go onto the shoulder, give a slow signal with hand and arm or by flashing the stoplight two or three times. If you give only a right turn signal, drivers following you may not expect you to slow down until you arrive at the next exit.

6. Ordinarily if a signal to slow down were needed on an approach for a right turn it would precede a signal for a right turn. On approaching a freeway exit, however, you may need to start your electric signal for a right turn in advance of a slow signal, which you may give later by flashing your stoplight when you first let up on the gas pedal.

7. If your driving experience on four-lane roadways has been limited to urban speeds, you are likely to cause trouble for yourself and others on freeways. The following suggestions may help you avoid this trouble:

a. When you enter an entrance ramp, divide your attention between the vehicles ahead of you on the ramp and the vehicles behind you on the freeway, and when you enter an exit ramp, divide your attention between the vehicles ahead of you and the vehicles on the service road.

b. When you enter the freeway, stay in the outside lane until you accelerate to normal speed, or until you and drivers already on the freeway adjust to one another. Do not go directly into the inside lane in front of fast traffic, unless your safety belt is tight.

c. **Drive in the center of your lane** both on straightaways and on curves. When traffic is heavy stick to the center of your lane as a train does to a track. Cruise within the posted limits unless traffic or weather conditions make the minimum posted limit an unsafe speed.

d. Select the lane where the fewest vehicles will need to change lanes to pass you. However, if you are traveling at the maximum speed allowed, you do not have to go to a lane

where you would need to reduce your speed in order to let speeders go by without changing lanes. A defensive driver may do it for protection. (It is important to know whether your speedometer is correct.)

e. Change lanes as few times as possible and signal and look to the side (or in outside mirrors) before changing lanes. There absolutely is no substitute for looking to the side to clear traffic before you change lanes.

f. Refrain from weaving in between and around vehicles at close quarters. Weaving is committed when a driver in changing lanes to go around vehicles does not give a signal long enough for other drivers to react to his signal and to cooperate with him before he changes lanes, or when he changes lanes in such a narrow opening that he is in danger of clipping the vehicle ahead or of cutting in on the vehicle he is overtaking and passing.

g. Keep your car a longer distance from the vehicle ahead than you think is necessary, and reduce your speed when you see a vehicle ahead in your lane traveling below the minimum speed limit. When you overtake a vehicle in your lane too fast you must be prepared to brake or change lanes quickly. Such maneuvers are dangerous on a freeway.

h. Give signals earlier than you think is necessary to warn drivers that you intend to change lanes or to slow down for an exit. This precaution is especially important when you approach a fork in the roadway where many direction signs are posted and you may have to congest traffic in order to find the sign you wish to follow.

i. Avoid the serious mistake of trying to change from the inside lane to the middle lane, if there is one, or to the outside lane in too short a distance, even though you have been giving a turn signal. Change lanes gradually. This does not mean you should straddle a lane line for a long distance. Your car should be going across the lane line all of the time.

j. Look for the advance destination sign giving the name of the route or street where you want to leave the freeway so that you will not be forced to pass up your exit. If you see the exit sign when you are in the middle or inside lane, you may not be able to change to the outside lane gradually. An abrupt change to reach the exit might scramble cars--a very unsafe practice.

k. By all means keep a lookout for speed zone signs so that you can adjust your speed up or down to avoid a collision or to prevent congestion. Adjust following distances to speed zone changes. You can shorten your following distance when a zone speed decreases, as from 50 to 35 mph, and lengthen your following distance when the zone speed increases, as from 35 mph to 50 mph. At speeds over 50 mph triple your mph for following distances in feet.

l. A safe following distance is the "Two Second Rule." When following another vehicle pick out a fixed object on the side of the road such as a sign, overpass, or bridge railing, then watch when the vehicle ahead of you reaches that point and count two (2) seconds. If at that time your vehicle has not yet reached the same point you have a safe following distance.

m. Lower your headlights when the freeway's divider strip is so narrow that high beams on opposing vehicles make seeing down your lane difficult. This is a clue that your high beam is illegal. If the two roadways on a freeway are close enough that your high beam will project glaring rays in the eyes of an oncoming driver, the high beam is illegal. If lights of opposing traffic bother you, move to the outside lane. If high beam lights behind you interfere with your seeing, hold your hand over or wave it across your rearview mirror to signal the driver behind you to lower his lights. Also, change the rearview mirror from day to night position if so equipped. Remember how disturbing a high beam behind you is when you are following a vehicle.

n. When you are in an outside lane carrying heavy traffic and you see vehicles on an entrance ramp or in an acceleration lane waiting to enter traffic, you might be able to adjust your speed up or down to create an opening ahead of or behind your car for a vehicle to enter. You would speed up only when you are so close to the ramp that it is obvious that a waiting vehicle will not enter in front of you. Compare the distances from your car to vehicles ahead of and behind you in determining whether an increase or decrease in your speed will enable you to create a gap long enough for a vehicle to enter safely. Before decreasing your speed you should check to see that the distances to and between vehicles behind you will make it safe. Sometimes light traffic in the inside lane will permit you to move to that lane when you approach an entrance ramp where a vehicle is approaching the freeway or is waiting on a ramp. These are examples of how you can blend with traffic to prevent congestion. You should practice such blending on any road. The more you practice blending the easier it will become for you to recognize opportunities to blend. The sharper you become in recognizing congestion traps, the sharper you will be in recognizing and avoiding collision hazards. Each skill requires eye and mind attention to traffic. A collision is a form of congestion.

o. When you are in the outside lane approaching an exit, keep an eye on any vehicle just ahead of you in the lane to your left. Its driver may suddenly recognize the exit as the one where he wants to leave the freeway and involuntarily cut in front of you without signaling. He may in this situation make an unsafe turn which he would not make at a cross street intersection, because he knows that on a freeway he may have to travel a considerable distance to correct the error of passing up his exit.

p. When entering a freeway on an entrance ramp or in an ac-

celeration lane always leave enough space between your vehicle and the vehicle in front of you for a vehicle already on the freeway to blend between you. If you have to stop on the entrance ramp or acceleration lane because the vehicles ahead of you could not blend and had to stop, do not try to enter the traffic lane before the vehicles preceding you have entered.

DRIVING IN FOG

1. In one chain of fog accidents 17 vehicles were involved. Some of the drivers complained to the state police for not having officers present to keep them from driving too fast. The drivers probably would have complained before the accidents occurred had they been asked to drive at speeds and follow at distances necessary for safe travel in fog.

In fog there are three different factors limiting the top safe speed of a vehicle. They are the perception time of the driver, the reaction time of the driver, and the braking distance of the vehicle. These three factors are present in open weather, but they create a more complicated problem in fog.

2. Perception time is the most important factor because it makes too fast for conditions a speed which the two other factors might permit. In open weather, the perception time a driver has in which to see and recognize a hazard may be several seconds or it may be very short, depending upon physical obstructions and the driver's eye and mind attention to the area around his car. On a straight, level road the time may be several seconds. At a blind intersection or at a hillcrest the time may be very short.

In clear weather a driver has a wide field of vision around which he can see long distances. Hazards in or approaching his path attract his attention against a background of land or horizon at considerable distances from his car. When he can see well beyond an obstacle that is close enough to be an immediate hazard, he usually can detect the obstacle at a greater distance from his car. When conditions such as fog hide the background, a driver's perception time will be longer than in clear weather and consequently he will have less time in which to stop in an emergency. Although a driver in fog cannot see an obstacle as far away he can give himself more time in which to detect and avoid an obstacle by reducing his speed. This is the only way in which he can give himself perception time equivalent to that in clear weather.

3. A driver does not realize how much he depends upon the background distances he can see around a wide field when traveling in open weather until he drives in a fog. If a driver in scanning his field of vision normally identifies hazards easily at a point 1200 feet from his car when it is moving 60 mph, and a curtain of fog limits visibility to 600 feet, the driver will have to drive at 30 mph or less to have seeing advantages similar to those he had in open weather at 60 mph. If the fog curtain [illegible] feet away, a comparable safe speed would be 15 mph. At each of these speeds the driver maintains between his car and the curtain of fog a period of 14 seconds in which to perceive (see and recognize) a hazard, react, decelerate with his car under control, and leave a margin for differences in perception times and reaction times of other drivers and differences in the braking efforts of their vehicles. In fog at 30 mph the driver's perception time will be longer than in clear weather at 60 mph due to the lack of background seeing, but his reaction time distance and braking time will be less due to the lower rate of speed. (The braking distance at 30 mph is only one-fourth the distance at 60 mph.)

4. The closer the fog curtain is to the driver the longer his perception time becomes. More unseen hazards such as cars, pedestrians, and animals can move about close to him just beyond the fog curtain. In open weather he could notice several of these obstacles at the same time, perceive the order of their importance to his safety, and deal with them in sequence. The shorter the radius of the fog curtain, the less able he is to do this. When he notices a hazard at close range he must give full attention to it instantly. If another appears at the same time from another direction his perception time may be so long that it will extend into a collision. In clear weather, hazards appear at the same time but at varying distances from his car. In fog when hazards are first visible at the same time they are always the same distance away.

5. The rule for reducing the speed in proportion to the visibility allows for this increase in perception time. The reaction time distance at 15 mph is only half that at 30 mph but the braking time at 15 mph is one-fourth that at 30 mph. The lower the speed the greater the driver's relative safety margin. But the closer the fog curtain is to him the more he will need the margin to compensate for drivers who do not recognize the problems of driving in fog.

6. When a number of vehicles collide rear-end in a fog, the lead driver was overdriving the fog's visibility and the other drivers either were overdriving the fog's visibility or (if each of the drivers was close enough to see the vehicle ahead) were following too close.

In open weather the following distance is based on the driver's perception time plus his reaction time plus a margin for a difference in the two vehicles' braking effort. The braking distances of the two vehicles going the same speed will be the same if the brakes on the two vehicles are equally good and the drivers apply their brakes with the same pressures. Any lag between the application of brakes by the front driver and the decision to apply brakes by the rear driver becomes part of the rear driver's perception time. This lag could be a half second or several seconds.

In fog the top safe speed of a lead vehicle is based on the driver's perception time plus his reaction time plus the vehicle's braking distance. The braking distance is involved because when the lead driver first sees a vehicle ahead in a fog the vehicle may be stopped.

In fog the following distance also must be based on the braking distance. In open weather a following driver not only can tell when a vehicle starts slowing down but also can tell whether an obstacle is within the stopping distance of the vehicle ahead. In fog he may not see this far. If the driver of a vehicle ahead is overdriving his stopping distance and suddenly strikes a stopped car, most of the vehicle's braking distance may be absorbed in the collision. The driver behind, following at a distance normal for open weather, suddenly finds he needs braking distance as well as perception time distance and reaction time distance.

Therefore, if the driver of a lead vehicle is overdriving his stopping distance, or if the driver behind cannot see as far as the stopping distance of the lead vehicle, the rear driver must follow at a distance nearly twice as long as the safe distance in open weather. At 30 mph he should follow at a distance of at least 100 feet.

7. The following newspaper items point up two driver errors. One is driving too fast and/or following too close in a fog and the other is failure to maintain eye and mind attention to driving:

The truck driver jammed on his brakes to avoid running over the trim little sports car ahead of him on fog-shrouded Highway 99 last night. Result: More than a score of motorists were injured, five seriously, and 24 automobiles, and a truck wrecked. The fantastic pileup stopped traffic in both directions for three hours.

After the first series of rear-end crashes behind the truck, motorists in the southbound lane slowed to see what was happening. Then the chain reaction began in that lane.

Not long after the above described accidents another series occurred on the same highway. Result:

Two truck-trailers, a bus, and about 15 cars piled up in heavy fog Sunday. Two persons died in flames and eight were hurt.

The northbound trailer turning across US 99 at an intersection was struck by a southbound trailer. The northbound trailer tipped over blocking southbound lanes. Two cars plowed into the wreckage, one behind the other, and burst into flames. Oncoming cars in both directions began smashing together as drivers slowed to peer through the fog at the flaming disaster. It was crash, crash, crash—one crash after another.

DRIVING IN SANDSTORMS

1. Airborne dust or sand varies in density much as fog and presents similar driving problems. The density of a sandstorm may increase so gradually after a driver enters it that the driver may not be aware of the exact point at which he is overdriving his stopping distance. The sand thickens for a second or two, then thins enough that the driver decides to hold his speed. It thickens and thins again but it thickens just a little more and thins a little less than it did the last time—this is, if the driver is still approaching the center of the storm. If a driver holds a speed safe for the average visibility he is experiencing he will be overdriving his stopping distance about half the time. After driving too fast through a few storms an optimistic driver becomes an old-timer, and forms a habit of "pushing on" at 50 mph when he should be going 35 mph or at 35 mph when he should be going 20 mph or at 20 mph when he should be parked. That is the history of a driver you may have read about—one who kept "pushing on" until he pushed himself and his passengers into the hospital or morgue.

2. Since the energy of a moving car, and therefore the car's braking distance, increases by the square of the speed of the car, a driver is in more danger of a severe collision in a sandstorm when the visibility is fair than he is when the visibility is very low. For example, if the visibility is low enough that a driver will reduce his speed to 42 mph, the driver is safer than he would be if he figured the visibility good enough for him to push on at 60 mph, even though in both instances he is overdriving his stopping distance. And he would be safer if low visibility should force him to a speed of 30 mph instead of remaining good enough for him to push on at 42 mph, even though in both instances he is overdriving his stopping distance. The reason is that the energy and braking distance are only half as great at 42.4 mph as they are at 60 mph, and only half as great at 30 mph as they are at 42.4 mph, and only half as great at 21.2 mph as they are at 30 mph. A car's energy decreases in the same way it increases, by the square of the speed.

3. Assume sandstorm visibility is 300 feet. A driver might conclude that speeding at 60 mph is absolutely safe, since a 150 feet following distance can be safe enough in open weather to follow a car going 60 mph, and 150 feet is only half of 300 feet. He fails to consider that in open weather he usually can see far beyond the car he is following at 150 feet.

Let us assume that in the sandstorm with visibility 300 feet the driver suddenly sees a vehicle 300 feet away and sees that this vehicle is stalled or has been suddenly forced to a crawl due to a rapid increase in the density of the sand. While our driver takes 1 second to see and recognize that the vehicle ahead is stopped or barely moving, he travels 88 feet. While he takes ¾ second to react and get on his brakes he travels 66 feet more. His perception time and his reaction time have now used 154 feet of the 300 feet, but at 60 mph he needs about 200 feet braking distance in which to skid to a stop without striking the stopped vehicle. He has only 146 feet open. After he skids the 146 feet he will strike the stopped vehicle at a speed of 31.5 mph. This is a result the average driver will hardly accept—that when he can brake to a stop from 60 mph in 200 feet, he reduces his speed only 28.5 mph after skidding 146 feet of the 200 feet—that is, reducing his speed only 47.5% while using up 73% of the total braking distance. This is an example of the deception which is the result of the square principle of kinetic energy. And it is an important cause of poor driver judgment in sandstorms and fogs.

4. Occasionally, a driver is already in a sandstorm before he knows he is in one which makes any driving unsafe. If he is a "push-on" driver he turns on his headlights; then he gets his speed down to a crawl; finally he gives up and stops on the shoulder. He may continue his crawl on the shoulder so that he will be farther from opposing traffic which sometimes wanders into the wrong lane. On the shoulder, of course, is where he might expect to run into vehicles which have already parked, and it is where parked drivers might expect to be struck by a "push-on" driver. If visibility is low enough to force you to park on the shoulder, you will always be safer if you go to the borrow ditch and "camp" until visibility improves. Keep your lights on and run your engine occasionally to keep your battery up if you must stay parked very long. Do not run the engine long with windows closed. If a muffler or exhaust pipe is defective, enough carbon monoxide gas to knock you out may seep through the firewall and be trapped inside.

5. While a vehicle is standing in a sandstorm, fine dust may accumulate between the brake shoe and brake drum on one or more wheels and cause the braking efforts exerted by right and left brakes to be unequal. This situation will cause the vehicle to pull to one side when the driver applies pressure on the brake pedal. If one of the front brakes is so affected, a hard application of the brake pedal could start a spin. After your car has been exposed to a sandstorm while parked, always test the brakes at low speed immediately after starting. If braking efforts are unequal a fairly hard application of the brakes over a short distance at low speed may lessen the hazard. Speed should be kept low until the defect is corrected. Steering slightly against the pull as you brake will exert a force opposite to the pull and help you maintain lane position.

6. It is possible for a windshield to be scored so badly in sandstorms that it will be a seeing hazard, especially at night. It may induce eye strain day or night. If your windshield has been scored and you notice yourself at night leaning your head forward or straining your eyes in order to see better between the scratches, you need to have your windshield replaced.

7. The hazards of driving in a sandstorm are depicted in the following digest of an accident investigation report.

During a severe sandstorm in 1958 on US 80 east of El Paso a 1952 Plymouth ran into the rear of a 1958 Ford. The drivers of these two cars had gotten out and were surveying the damage with both cars standing in the roadway when a 1955 Cadillac plowed into the rear of the Plymouth. The force of this impact knocked the Plymouth into a second collision with the Ford. Then a tractor-trailer petrochemical truck carrying a load of sulphuric acid rammed the rear end of the Cadillac. The Cadillac was catapulted into its second collision with the Plymouth, and the Plymouth was knocked into its third collision with the Ford. During the latter collisions the Cadillac and the Plymouth were scattered off the roadway and the tractor-trailer struck and ran over the trunk of the Cadillac. Both the Plymouth and Ford caught fire and the Plymouth's destruction was completed by fire.

One man and one woman in the Ford were killed. One man and one woman in the Plymouth were killed. Two women in the Cadillac were injured.

Besides occupants of the vehicles involved there was one "witness" to this series of seven distinct collisions. It was a man sitting in his car parked on the shoulder across the roadway from the accident scene. While due to low visibility he could not actually see everything that was happening, he heard the several impacts. While this driver was saving his life at the cost of a little time, four "push-on" drivers sent four persons to the morgue and two persons to the hospital and destroyed or severely damaged three automobiles.

DRIVING ON SLICK ROADS AND RUNNING OFF ROADWAY

1. Effects of Slick Pavement

a. The present Texas brake law requires a minimum braking effort of 52.8% for all passenger vehicles. That is, a car's brakes must be able to exert a retarding force equal to 52.8% of the vehicle's weight. When a pavement is so slick that the coefficient of friction (f) is lower than 0.528, the slick road produces a hazard similar to that of driving on a dry road with illegal brakes. (A car's brakes cannot exert an effective retarding force greater than the f value of the pavement. The f value represents the retarding force a pavement can exert against the tires on locked wheels.) See footnote page 49.

For example, in National Safety Council tests a car going 20 mph on hard-packed snow skidded 62 feet. This is equivalent to a braking effort of 21%, the best the car's brakes could do, because the f value of the snow surface was 0.21. A car going 30 mph on this snow would require 140 feet to stop. Now, if the f value of a dry pavement were 0.6 and your car had 60% brakes, your braking distance at 30 mph would be 50 feet and at 60 mph would be 200 feet. To stop on the snow in 50 feet you would have to reduce your speed from 30 mph to 18 mph, and to stop in 200 feet you would have to reduce your speed from 60 mph to 36 mph. (See Winter Driving)

b. Slick pavements cause loss of traction when the front wheels are turned quickly and when the rotating speed of the rear wheels is changed quickly in accelerating or in braking. When traction is lost a car may skid. On most wet pavements speeds must be reduced to prevent frequent loss of traction. An experienced driver can easily tell when his tires are losing traction. Before this happens he should reduce his speed to prevent the loss of traction.

c. When you turn the front wheels, the wheels revolve along a direction inside the path along which your car moves. The angle between the longitudinal axis of the car and the direc-

tion the wheels are headed is called the slip angle. Smooth front tires cannot exert the turning force that good treads can. The sharper you turn smooth tread tires on a slick road the less turning force the tires will develop and the easier it will be for the car to continue in the path it is headed. While the same result can occur when you overturn rib tread tires, a smooth tread will exert less turning force than a rib tread at a given slip angle, and a smooth tread will lose its turning grip faster than a rib tread as the slip angle increases.

2. Anticipating Slick Places

a. When you approach a different type of pavement in wet weather be alert for a lower value of f.

b. If the pavement you are on is covered with traffic film, slow down before entering even a light shower. The road will be treacherous until enough rain washes the film away.

c. In freezing weather approach bridges cautiously, even if the adjoining pavement is dry. Water may have condensed on the cooler bridge pavement and frozen.

d. Beware of fine silt that has washed onto the pavement in wet weather.

e. You should be able to recognize oily areas due to asphalt bleeding in hot weather.

f. A grass-covered shoulder may be very slick. Do not pull onto one expecting to stop quickly.

3. Preventing Skids on Slick Roads

a. Lower your cruising speed and increase or decrease your speed at a slow rate. Pump brakes slowly, except on ice. (See f. below)

b. Reduce speed for short turns so that you can turn the wheels gradually.

c. Ease off on the gas while your car is crossing a slick place in the road.

d. Ease off on the gas when you feel the drive wheels losing traction.

e. Keep the kinetic energy of your car down. All of the energy must be dissipated before the car will stop. When you reduce your speed from 50 mph to 40 mph, in this 10 mph you reduce your energy the same amount as your car possesses at 30 mph. When you reduce your speed from 30 mph to 20 mph, in this 10 mph you reduce your energy more than your car has left at 20 mph. A driver should understand these relationships of energy to speed and he should think of this energy as a destructive force which will "explode" if he hits a fixed object.

f. If the road is very slick, start your car in second or high gear. In slowing down on packed snow, sleet, or ice, ease into second gear. Engage the clutch slowly. National Safety Council tests indicate that a driver can slow down on ice faster by fanning the brake pedal rapidly. This procedure slows the wheels with less risk of a driver's applying too much pressure or holding it too long.

g. Snow tires reduce braking distances 13% on loosely packed snow and 11% on glare ice, under regular tires. Tire chains reduce braking distances 23% on loosely packed snow and 49% on glare ice, under regular tires. (N.S.C. Tests)

4. Recovering from Skids on Slick Roads

a. In minor skids you need only to ease off on the accelerator and the car will straighten up. Such skids will occur frequently on a muddy dirt road. As the car straightens up, ease on the accelerator.

b. In major skids, such as occur in curves or in overbraking, turn the front wheels in the direction the rear wheels are skidding in order to get the front wheels back in the lead. If you are braking when the skid starts, get off the brake pedal and ease in the accelerator as needed, to line up the front and rear wheels. Sometimes you may not have room to follow this procedure. It can be very dangerous in a curve to the right if you are meeting a vehicle. You may want to steer away from the vehicle even though your car goes into a spin in order to prevent a serious accident.

c. You cannot recover from skids mechanically, in a one, two, three procedure, and no one can tell you exactly how much pressure to put on the controls or the sequence of using the controls. You know what you want the car to do. If you understand physical laws and you have developed a "sense of car control," you will be able to coordinate the steering wheel, the accelerator, the clutch, and the brake effectively to control the car. If you lack this "feel" and know-how, you may overcontrol and wreck your car in a hazardous situation from which you should recover with relative ease. A defensive driver is one who has learned how to control his vehicle and how to steer out of hazardous situations. Until a driver develops a kinesthetic feel of a car in motion he should drive at low speeds.

d. The top safe speed to drive after you recover from a skid on a slick road will be slower than the speed at which the skid originated.

5. Running off Roadway

a. If you car skids or runs off the roadway and the shoulder is open, do not be in a hurry to get back on the pavement. The shoulders are built for such an emergency. Bring the car under control on the shoulder and enter traffic again in a normal manner. A normal entry requires you to look back out of the driver's window to check traffic before returning to the pavement. This is an absolute must, no matter how short a time you were on the shoulder.

b. If one of your right wheels should drop off a pavement that has a low or rough shoulder, avoid any quick movement of controls and especially do not attempt to jerk your car back onto the pavement. Maintain control straight ahead and reduce speed, driving to the right just enough to straddle the pavement edge. When your speed is under control and there is no vehicle meeting or overtaking you, move back onto the pavement quickly and smoothly. If you cut back before you slow down, you may overshoot your traffic lane and lose control of the vehicle. If a vehicle is meeting you, you could cause a head-on collision.

Cutting the wheels at an angle to a pavement edge which is higher than the shoulder enables your wheels to roll up on the pavement without hanging on the edge of the pavement. If the shoulders are low and rough as far ahead as you can see, reduce your speed, clear traffic, and ease back over the pavement edge slowly.

If one wheel drops off a pavement where the edge is rough or the shoulder is low, and traffic is heavy or a driver is so close behind you that he may start to overtake and pass you, you should slow down and drive on off the pavement. When traffic is clear, make a normal entry into traffic.

c. If you are pulling a trailer,* be sure all trailer wheels are back on the pavement before you accelerate. Otherwise, a trailer wheel might ride along the face of the raised edge under tension and suddenly jump onto the pavement and swing the trailer across the centerline into the path of onposing traffic. This tricky hazard has killed many innocent people. Trailer hazards are many, and they are aggravated by drivers who try to handle a car and trailer as they do a car alone. A driver who pulls a trailer which does not track properly (wheels swing back and forth sideways) or which is not safely hitched to his car is negligent. If he pulls such a rig at normal cruising speeds he is a real menace to public safety, because a trailer wheel is likely to run off the pavement, hang on a pavement edge, and break the trailer hitch or throw his car out of control.

* Trailers should be loaded more heavily in front. They will whip and sway if they are loaded evenly or if more weight is in the back.

d. When you approach a bridge, be sure your car is in the center of your lane to eliminate any chance of a wheel getting off the pavement. This is defensive planning. You can see that you would not have time to recover or stop if a wheel should drop off onto a low shoulder near a bridgehead. The following review of a Texas accident points up the "run off roadway" hazard and the "overtake and pass" hazard on the approach to a bridge: A driver, in going around a truck near a bridge, drove too close to the left-hand shoulder. Her left rear wheel dropped off the pavement. This scared her. She jerked the wheel to the right to avoid hitting the left bridgehead. Her car sideswiped the left front fender of the truck. She then jerked the wheel to the left (she is on the bridge now) and hit the left-hand banister. She jerked the wheel back to the right and went over the right-hand banister. Four people were killed.

An analysis of the accident reveals several possible causes:

The driver either did not know the law prohibiting driving to the left of the center line on the approach to a bridge or did not recognize the hazard against which the law was designed to protect her and her passengers.

The driver lacked the skill to drive in the center of the lane at a time when this procedure would have helped her most.

The driver drove too far to the left probably because she was unable to judge distance between vehicles during a close-in maneuver.

The driver oversteered in returning her car wheels to the pavement and this error was aggravated by her pushing of the gas pedal instead of relaxing it.

After the first collision (with the truck) the driver went into panic and her right foot probably froze on the gas pedal.

The driver obviously knew very little about seeing and recognizing hazards, planning ahead, and how to control a car in an emergency.

DRIVING IN MUD

1. When the roadbed is hard and the mud is shallow, drive very slow in a higher gear at a steady pace. The car may slide about frequently. Condition yourself to this sliding and do not expect a rapid recovery when you correct for a skid with the steering wheel. Use only enough power and steering to keep the car moving in a relatively straight path. If a lower gear is needed on a grade to maintain momentum for manual transmissions, engage the clutch smoothly and return to high gear as soon as possible.

Coordinate clutch and accelerator to regulate speed and power and avoid using second gear, which will overheat the engine faster and will aggravate skidding. If the road is **graded** and the **rear wheels** should slide into a borrow ditch, shift to second gear immediately, cut the front wheels to the right at a 45 degree angle to the road, and add power to keep up the car's momentum until it pulls you back onto the road. You might go several hundred feet in this position before you get enough traction to pull out, but the alternative may be a stuck car.

2. When the mud is deep and there are ruts, it may be desirable to follow the ruts except where they are so deep that your car will hit a high center. If the mud is slushy a little extra power will push your car over high centers. If the mud is stiff and the ruts are deep you may get stuck solid on a high center. You may then fare better by leaving the ruts when they appear too deep. If you have a choice of ruts of the same depth, those with water in them may be easier going than the others, because the mud may not be as stiff. Ordinarily second gear will be needed. It will provide power in a hurry when needed to keep up the car's momentum, yet enable you to move at a moderate pace. Use the clutch to help regulate speed and to increase power quickly.

3. When both rear wheels are stuck and a short try in low gear stalls the engine, back up a few feet and go around the rut. If you cannot do this, back up about 10 feet for room in which to get up momentum forward to push you out. If only one rear wheel is stuck and you cannot go forward or backward, cut off the switch, get out and take stock. If you keep spinning the free wheel it may dig a hole and drop the car's differential onto high center. To prevent the wheel from spinning, place weeds, grass, paper, small rocks or small tree branches along the rut in front of or behind the wheel. You may need only to get traction for the spinning wheel in order to make the other wheel pull. The other wheel may not be stuck. Check for a rock or other solid obstruction in front of the front wheels and place brush or rocks under them to get a car off high center. Engage the clutch slowly to avoid spinning the wheel too fast for it to grab hold of the traction materials. If you must be towed out, fasten the tow rope or cable to a place on your car where it will pull directly on the frame. One such place is a member to which a bumper is fastened. It may be appropriate to add here that mud chains should be put on before driving in heavy mud. Often a driver ponders this wisdom after he is struck.

DRIVING THROUGH WATER AND IN A RAIN SQUALL

1. When water overflows a highway, determine its depth before attempting to drive through. Look for a depth gauge beside the road. If the water is deep or swift, do not attempt to cross. If there is no gauge and you cannot judge the depth, you gamble if you cross and you do not know the odds.

2. If you must attempt to cross water on the road, drive slowly in second or low gear and keep moving at a constant rate of speed, so that the trough created by your car will not fill up and cover the tail pipe. Do not let fear cause you to speed up when the water gets deep. This act may increase the pressure of flowing water against one side of your car. The time to show fear is before you start, not after.

3. After going through water drive slowly in second gear and hold the brake pedal down until the brake linings dry out. Do not drive fast until the brakes hold uniformly.

4. When rain is so heavy that visibility is limited to a hundred feet or so, pull as far off the roadway as you can, safely, and park. Leave headlights on low beam. Usually the heavy rain in a squall will last less than a half hour, and you would gain little and risk much, groping through the rain at 15 mph. The best time to park is before a rain storm hits. Do not park near a tree because lightning may strike it. Avoid parking where electric lines, if blown down, might strike your car. If an electric line ever touches your car, do not touch the ground while you are touching the car, until you are sure that the line is dead. Otherwise you may be. In an electric storm without rain you will be about as safe moving as parked.

5. Once you are in a blinding rain, you will realize how important good wiper blades are and the advantage of booster equipment if your car has vacuum-type wipers. Without booster equipment your wipers may stop operating momentarily when you accelerate.

6. If mud is thrown on your windshield after a rain, turning on your wipers may smear the mud over your windshield and obstruct your vision. Stop and wipe the mud off with the handy rag which you should always carry in your car. The mud will not be a problem if your wipers are equipped with a water spray. When you want to buy something for the car, think of equipment that may aid you in avoiding a collision. Money spent for such equipment is a sound investment.

PROBLEMS AND PROCEDURES INVOLVING TRUCKS

1. Trucks present special driving problems, to which a driver must give conscious attention in order to maneuver near the trucks safely.

a. Trucks may restrict a wide field of the driver's vision. A driver can see through and over a car, but he cannot tell what is taking place on the other side of a truck.

b. Trucks have a longer turning radius than cars and cover a wider path in turns. Drivers who do not observe this turning pattern are apt to stop their vehicles in the path of a turning truck.

c. Loaded trucks usually cannot accelerate or decelerate as fast as cars. The mass of a truck and load may weigh 15 times

the mass of your car and load. You should expect a heavy two-axle truck going 30 mph to take 92 feet to stop after the driver applies his brakes. And a heavy three-axle combination, 115 feet after brakes are applied. At 45 mph these braking distances would be 210 feet and 260 feet, respectively.

d. Heavily loaded trucks develop a tremendous amount of kinetic energy. A 50,000 lb. truck and load going 30 mph possesses the same amount of energy as a 4,000 pound car going 106 mph. While the two vehicles could cause equal damage in case of a collision, the car would be in much greater danger of collision, because its rate of speed would cause the driver to commit position violations frequently. The truck operator can control the high energy of his truck because his speed is low and within the range of physical limitations of himself and his vehicle. On a pavement where the truck at 30 mph would require 60 feet in a locked wheel stop the car at 106 mph would require 749 feet.

e. Trucks make more noise than cars. This noise also makes it difficult for a truck operator to hear a car's horn signal.

f. Trucks may be mental hazards to some drivers. That is, some drivers may tense up when meeting or passing trucks in close quarters. This may be due to the truck's height, width, and noise, and the rocking that cars get from air gusts when meeting big trucks or buses on rural highways.

2. Driving Procedures Involving Trucks

a. When overtaking a truck upgrade on a two-lane road plan to pass it soon after it reaches the top of the grade when the truck's speed will be low.

b. When following or meeting wide trucks, look for electric turn signals. Do not expect hand and arm signals.

c. Follow a truck at a greater distance than you would a car so that you can see what is going on down the left side of the highway.

d. When a truck is following you, avoid abrupt braking and give signals earlier than you would for cars, because if the truck is heavily loaded the operator cannot decelerate the truck as fast as you can your car.

e. When you signal a truck with your horn, sound it loud. If the weather is cold and the truck's cab is closed, do not expect the operator to hear a horn.

f. Help keep trucks moving by slowing down or yielding, when convenient. It takes much longer for a loaded truck to stop and start than it does a car. The more we delay trucks the more the merchandise they carry will cost us.

g. You will need more time to overtake and pass a tractor-trailer combination than to pass a bobtail truck. You can recognize a combination at night by two air brake cylinders near the rear axle of the trailer.

h. When a vehicle ahead has several rear-end lights and its headlight beam is pointing upward you are overtaking a truck on an upgrade. You should expect the vehicle's speed to be as low as 10 mph. A truck at this speed presents a problem similar to a vehicle stopped in your lane. Decelerate your car in the same way you would if you planned to stop upon reaching the truck.

i. Do not be caught within hollering distance of a truck you are overtaking as it goes onto a bridge which has banisters within three feet of the pavement. The closer bridgeheads are to the traffic lanes the greater the hazard for two or more vehicles crowding together on the approach to a bridge.

j. Reduce your speed early and hold to the right side of your lane when meeting a wide truck on a narrow bridge. The nearer the banister you drive the slower your speed should be. If you reduce your speed late you may overbrake on a slick place you didn't see and slide into either the truck or the bridge rail. If the bridge is so narrow that it creates a mental hazard for you, or if the bridge pavement appears slick, you might go onto the shoulder at least 50 feet from the bridgehead and wait for the truck to pass. At a distance, your lane near a truck on a narrow bridge may look too narrow for your car. This illusion may cause you to steer into the truck or the rail unles you look down the center of your lane. The lane will appear wider if you reduce your speed.

k. Avoid placing your car in a position that might cause a truck operator to lock his brakes. The center of gravity of a loaded truck is high. If the truck's brakes are locked, the truck may swerve and tumble itself or its load on top of your car.

l. On any slick road downgrade a tractor-trailer combination out of control may jackknife all over the highway for several hundred feet. Improper braking on an icy road can throw it out of control easily. Avoid meeting or overtaking a combination that is going down an icy grade and keep your car out of any position which may force the operator to overbrake.

m. When you are overtaking a truck at night switch to low beam at least 300 feet from the truck and do not switch back to high beam until your head lamps pass the truck's outside

rearview mirror. Lower your lamps farther away than 300 feet if your low beam will give sufficient light for your speed.

n. Truck and bus operators can see beyond hillcrests which would obstruct the view of a car driver. You should not conclude that a truck is making a blind pass on a grade where a no-passing line is not present simply because you cannot see beyond the top of the grade. By the same token, you should not follow a truck or a bus in a pass on a grade beyond which you cannot see. There may be only enough clearance ahead for the truck or bus to complete its pass safely.

RAILROAD CROSSING PROCEDURES

1. A defensive driver has only to consider the momentum of a train to understand why drivers should be required to yield the right-of-way at crossings and why drivers should want to yield. Deadly as train collisions can be, some drivers give little or no thought to trains as traffic hazards. They may hurry to beat a train to a crossing with the same eagerness they would display in hurrying to catch a train. Other drivers respect trains but do not know how to cope with train crossing hazards.

2. Railroad crossing warnings with which drivers should be familiar:

a. Cross arm sign. (A small additional sign may give the number of tracks if there are two or more.)

b. Uniform round sign with a black cross. A double cross indicates more than one set of tracks.

c. Flashing red lights and/or electric bell.

d. Swinging disc and/or red light.

e. Engine horn, whistle, bell, or headlight.

f. Gates lowered across street.

g. Watchman with stop sign or latern, or a brakeman, when train is switching.

h. Highway stop sign.

3. You must stop your vehicle within fifty (50) feet but not less than fifteen (15) feet from the nearest rail and not proceed until it is safe to do so when:

a. A clearly visible electric or mechanical signal device gives warning of the immediate approach of a train.

b. A crossing gate is lowered or when a human flagman gives or continues to give a signal of the approach or passage of a train.

c. A railroad engine approaching within approximately fifteen hundred (1500) feet of the highway crossing emits a signal audible from such distance and such engine by reason of its speed or nearness to such crossing is an immediate hazard.

d. An approaching train is plainly visible and is in hazardous proximity to such crossing.

e. A highway stop sign is present.

4. You must not drive on the left side of a two-way street to overtake and pass a vehicle that is crossing railroad tracks or one that is waiting at a railroad crossing. In fact, you must not approach a crossing on the left side of a roadway within 100 feet of the tracks.

5. You should avoid shifting gears while crossing railroad tracks. If the approach to a track is upgrade, shift into second or low gear before reaching the tracks. If your car stalls on a track place it in gear and pull it off with the starter. If car is on an upgrade use reverse gear, if on a downgrade use a forward gear. If you cannot move your vehicle, exit quickly and move in the direction of the approaching train.

6. At multiple track crossings where vision is obstructed by buildings or boxcars, move cautiously in second or low gear and be alert for free rolling boxcars.

A free rolling boxcar in full view can run you down if you direct your attention only to engines or approaching trains.

7. At a multiple track crossing do not stop your vehicle on one track while waiting for a train to pass on another track. A fast train may approach on the track you are blocking and you may think its whistle is coming from the train for which you are waiting.

8. Raise your headlight beam when approaching a known railroad crossing or switchyard if you cannot see headlights meeting you. Otherwise you may drive straight into the side of a train that is passing a crossing. On low beam you may not see the train cars until they are inside your stopping distance. The results of almost stopping before colliding with a moving train is frequently death.

9. Before an impending collision with the side of a train, it may be better as a last resort to steer in the direction the train is moving, as you apply brakes. You cannot do this if your wheels are locked. This procedure may roll your car, but it may help your car carom off the train. The relative speed of your car with the train will be lower, and the more room you can make for slowing your car, the more energy you can lose before the impact.

10. If you have your car closed up due to rain or cold and you are

approaching a railroad crossing where vision in either direction is obstructed, roll down the driver's window a little to help you hear a train whistle or horn. When you hear a train whistle, horn or bell, in town, look for a crossing.

11. When you are stopped at a multiple-track crossing waiting for a train to go by, an approaching train going in the opposite direction may be hidden from view by the first train. Before crossing you should wait until the end of the first train is far enough away to let you see that the adjacent tracks are clear.

12. If a vehicle ahead of you obstructs your view of signals at a crossing you are approaching, reduce your speed so that you can stop before reaching the tracks from the point at which you can see the signals, after the vehicle is out of the way. The driver ahead of you may be violating a signal you cannot see. And his vehicle may be the last one that can get by the crossing without being struck.

13. Practice looking for railroad crossing signs until you are conscious of every one you see. A driver sees trains so seldom at crossings that he may fail to associate danger with a cross arm or round sign as he does with a stop sign or a signal light. After a time the cross arm or round sign may not signal his subconscious to take defensive action. When this state is reached the driver travels in a train-crossing trap which will snap on him when chance heads his car and a train toward the same crossing and times the two to arrive at points 100 feet to 200 feet from the crossing at the same time. Such timing is not rare. It happens to thousands of drivers every day. But the trap snaps only on those drivers to whom the crossing signs were meaningless.

DRIVER SIGNALS

1. Texas law requires drivers about to change course, turn, slow down, or stop, first, to see whether or not there is sufficient room to execute such maneuver safely, and then, to give the appropriate signal before changing course, turning, slowing, or stopping. Signals not only aid in preventing collisions but also aid in preventing delays that create congestion. Signals are drivers' only means of common communication in traffic. Signals transmit in code vital information which if accurate and sent in time can prevent damage to vehicles or injury to people. Driver disregard of signals portrays a lack of understanding of driver responsibility in modern traffic.

2. Although almost all vehicles are required to have electric turn signals, **hand and arm signals** are legal in Texas provided that when you give a signal your **hand and arm** can be seen by the drivers you intend to warn. A driver who gives a signal that is half way between right turn and left turn, or half way between left turn and stop signals, is not complying with the law.

a. Right turn: **Hand and arm** extended up from left side of vehicle.

b. Left turn: **Hand and arm** extended horizontally from **left side** of vehicle. (Do not drive within arm's distance of opposing vehicles when you give this signal.)

c. Slow or stop: **Hand and arm** extended downward from **left side** of vehicle.

The right turn and slow or stop signals can be seen more easily if you will extend your arm away from the car slightly. All three signals will be more conspicuous, especially at night, if the palm of your hand faces to front or rear.

3. Either hand and arm signals or turn signal lamps and stop lamps may be used. If your car has turn signal lamps you may need to use them at times even though you give hand and arm signals. A red or amber stop lamp that lights up when the brake pedal is depressed may be used as a slow or stop signal, but you should flash it early to provide ample warning, unless of course you are forced to make an emergency stop. A glaring or dazzling stoplight is illegal. Even a proper signal cannot protect you unless it is seen by all other drivers with whom you might conflict. For example, if you are ahead of a big truck in an inside lane and you signal to move into the outside lane, a driver overtaking the truck in the outside lane may collide with you if he did not see your right turn signal.

If you are overtaking the truck you would still be involved in the same trap. Hence, a driver must not only give proper signals but also must know that the signals are being seen by drivers he wants to warn and, furthermore, he must be alert to detect signals given by others and to expect movements of drivers whose signals were hidden from him.

4. A **hand and arm** signal given in conjunction with a signal lamp is a good defensive procedure under the following conditions:

a. The first vehicle behind you, especially a truck, may prevent the driver of the second vehicle behind you from seeing your stop lamp or your turn signal lamp.

b. In heavy city traffic where there are many distractions for all drivers and where many drivers are looking for road markers or street names, a hand and arm signal aids in attracting other drivers' attention.

c. Sometimes it is important that you inform drivers you are meeting or drivers approaching from your left that you plan to slow down or stop, or to remain stopped, until they clear your path. Only a hand and arm signal will transmit this information, because these drivers cannot see your stop lamp.

d. When several vehicles are following you in fast traffic and you detect a hazard ahead which requires you to slow down or stop, you should signal early by flashing your stoplight to give the driver behind you time to relay the signal to the driver behind him, etc., before you start any abrupt braking. If you

do not you may cause a rear-end collision between two or more of the vehicles behind you. By giving a hand and arm signal and easing to the left in your lane you are able to warn several drivers behind you at the same time and eliminate the signal lag. If the hazard ahead of you is close, a hand and arm signal may be the only way to prevent a rear-end collision between vehicles behind you.

5. When a driver turns onto a right shoulder the law requires him to give a right turn signal at least during the last 100 feet before turning. If a vehicle is immediately to the rear of the driver planning to turn right, the law requires the turning driver to give a slow signal before he suddenly decreases his speed. A defensive procedure in fast traffic would be to give a slow signal at least 300 feet before decelerating abruptly and to start a right turn signal at least 300 feet before starting the turn. These distances may or may not overlap depending on where braking is started and the rate of deceleration.

6. It is just as important to give a signal to tell pedestrians at an intersection what you intend to do as it is to inform drivers. A pedestrian may stop or alter his direction to your advantage if he knows ahead of time which way you want to go.

7. When you see a vehicle in opposing traffic giving a left turn signal, it may be wise to alert drivers behind you with a slow signal, even though the signaling vehicle may be a block away in city traffic or a fourth of a mile away in rural traffic. If the signaling driver should suddenly turn left through a break in traffic, you will already have the drivers behind you prepared to slow down.

8. After you complete a turn using a directional light signal you should check your turn panel light or signal light lever to make sure your turn signal is off. Sometimes an automatic off switch does not work, especially if you have turned only a few degrees. A driver who does not know that he has a turn signal flashing is a driver who does not check his instrument panel at regular intervals. When you see an electric turn signal that has been burning for some distance, you may assume that the driver is preoccupied. Keep an eye on him and expect the unexpected.

9. There are enough drivers who do not know or do not give proper hand and arm signals that you should be alert for a driver who may give a conspicuous right turn signal either with hand and arm or with lamps and then turn left. A defensive driver will consider the path and speed of the other car as well as the signal he sees (or does not see) before he decides what he should do. The position and speed of the car whose driver is signaling and the position and speed of other vehicles nearby may indicate that the signal being given is incorrect. Incidentally, a driver who changes his mind and fails to go in the direction he has signaled, presents to other drivers the same problem as one who gives a wrong signal through ignorance or one who does not know his signal is working. If you change from a left turn to straight ahead a meeting vehicle may turn left into your path. If you change from a right turn to straight ahead a vehicle approaching the intersection on your right may cave in the right side of your car. These two errors are just as hazardous as changing from straight ahead to a left turn without signaling. If you change your mind make sure you have time and room to change directions safely.

10. If you are not alert to the position and speed of a vehicle that is meeting you, you may fall into a trap such as the following: Suppose you and a meeting driver are approaching an intersection at about the same time and both of you are flashing left turn signals. Each of you has told the other that he will turn left. In turning, each car would pass in front of the other. Suppose the other driver is not aware that his directional signal is flashing (it failed to cut off after his last turn) and he has no intention of turning left. He sees your signal but he expects you to yield to let him go straight through. His speed (and perhaps his position) is the only clue you have to keep you from turning in front of him. This trap has a twin: Suppose the other driver knows his signal is flashing and plans to turn left, but you do not know that your signal is flashing and you intend to go straight through. If the other driver fails to observe your approach speed, he may cut in front of your car.

11. When bright sunlight strikes some directional turn signals at certain angles you may not detect the flashing of the signals. You should be alert to the position and change in speed of a vehicle you are following or one you are meeting as it approaches an intersection as a guide to a driver's intention to turn. When you are signaling a turn in bright sunlight, keep in mind that a driver following or meeting you may not see your flashing signal. You can compensate by giving a hand and arm signal and by reducing your speed and getting your car into proper position for the turn–early.

12. You are required to give a signal when you slow down or change direction even if the deceleration or turn is nominal. Even though an approaching driver may be exceeding the speed limit or may be a DWI, neither offense in any way relieves you of the responsibility of indicating by signal your intention to turn or slow down. Nor does the fact that you have given a signal give you the right to complete your maneuver if the maneuver will create a hazardous situation.

13. The position of another vehicle, its distance from you, and its speed and direction are factors that determine whether or not your braking or turning will create a hazardous situation. A turn that would not interfere with a vehicle 200 feet away in city traffic might cause a serious accident in rural traffic unless a signal were given. Also signaling your intention aids a driver you are following. If you are gaining on him and you plan to turn at the next intersection, your turn signal would assure him that you will not be passing him at the intersection, a maneuver which might prove hazardous to him. A student must learn to reason from the position of the other driver before he will be able to imagine the many ways in which the speed and movement can affect other traffic, even though his planned path will not lead to physical conflict with another vehicle.

14. The value of a signal depends primarily on the number of seconds the signal is given before a change of direction or braking begins, due to different speeds vehicles may be traveling. In city traffic moving 20 mph to 30 mph a signal 3 or 4 seconds before a turn maneuver may be sufficient, but in rural traffic moving 50 mph to 60 mph a signal 5 or 6 seconds before turning or braking may be necessary. If a slow signal is given with a stoplight, the light should be flashed two or three times by fanning the brake pedal before brakes are applied. It may help you to see whether or not you are giving signals in time for other drivers to react if you will count off the required seconds 1,001 — 1,002 — 1,003...etc., after you start a signal and before you start braking for a stop or reach the point where you plan to turn.

15. A driver who starts turn signals at the crosswalk is out of his league driving a car in modern traffic. This "Look, Mom-one hand" artist who signals during a turn with his left hand and juggles the steering wheel with his right hand and elbow is a traffic nuisance. Electric turn signals permit these drivers to keep both hands on the wheel in turns, where they should have been anyway. The crosswalk signal may inform a pedestrian moving 3 feet per second, but it will not inform drivers moving 44 feet to 88 feet per second.

16. When you approach an intersection for a left turn you should be giving a left turn signal before entering the intersection. If a vehicle meeting you is so close that you decide to stop and wait for it to come through the intersection, the best way for you to let the driver know that you will stay put is to give a hand and arm stop signal. The same procedure would be good also in preparing to turn left in midblock.

If you are giving the left turn signal with hand and arm, you merely have to drop the arm to a stop signal position. If you are giving the left turn signal with an electric lamp, you should leave it flashing while you give the hand and arm stop signal. In either case, should you give the hand and arm stop signal hold it until you are ready to move, then get your left hand back on the steering wheel.

The hand and arm stop signal will save you time and prevent confusion for both the meeting driver and a driver behind you. The meeting driver may not be sure you plan to let him go through if he sees only a left turn signal. He, therefore, will slow down more and you will have to wait longer. A driver behind you may think you will turn in front of the meeting driver and therefore may not slow down as early as he would if you were giving a hand and arm stop signal. If the driver behind you should hit you, he might say that you signaled you were going to turn, but instead you stopped, and that you did not warn him that you were going to stop in front of him in his lane. He would have a point. Flashing the stoplight also would serve here as a stop warning.

17. When you are waiting for traffic to clear, as when entering traffic or when making a left turn, and you are giving a hand and arm stop signal, discontinue the signal before you move your car forward. Otherwise, you may trap an approaching driver who may accelerate at the same instant you start up. Be sure you foot knows what your hand is doing. As long as you are holding the stop signal you are inviting approaching drivers to come on.

18. In giving a left turn signal you should be alert to the following trap which you might create for yourself. Suppose that you start giving a signal for an intersection some distance away and that between you and the intersection where you plan to turn there is a driver waiting on your left at a small side street which you disregard, because your mind is on the large intersection beyond. The waiting driver may assume that you plan to turn left into the side street on which he is waiting. He may then turn left in front of you without any warning, because you will have misinformed him. In such a situation you should not start the left turn signal until you pass the side street.

There is a special form of this signaling trap which is doubly deceptive. Suppose you are flashing a left turn signal as you approach an overpass intending to turn left into the one-way local road beyond the overpass. You are not concerned with the local road you will cross entering the overpass, because it is one-way to your right and you would not be permitted to make a left turn into it. But as you approach this local road there is a meeting vehicle coming off the overpass and flashing a left turn signal. It may not occur to the driver that you cannot legally turn left, and seeing your left turn signal, he may turn left directly in front of your car. After the collision you will say that you had the right-of-way over a car turning left at an intersection, and that you were giving a signal to turn left at the first intersection (across the overpass) at which a left turn was permitted. And what would you say if you were driving the car coming off the overpass? You might say that you were meeting a driver giving a left turn signal while approaching an intersection and that his signal gave you the right to turn left. That the driver was giving a left turn signal, that it was physically possible for him to turn left, and that it was his business whether or not the left turn would be legal. Neither one of these arguments can prevent the collision. One of the drivers must drive defensively, that is, be alert to the developing conflict and be able to reason from the position of the other driver. Had the driver going straight, entering the overpass, done this he would have waited until he crossed the local road before he gave a left turn signal. Had the other driver been alert to the one-way road and reasoned that the meeting vehicle could not turn left legally, he would not have been misled by the left turn signal.

19. When vehicles are approaching a common hazard (point of conflict), the vehicles' speeds plus their distances from the hazard determine the distances from the hazard the drivers should signal their intentions. If you will draw scale diagrams of a few traffic situations and analyze the relations between vehicle speeds, driver reaction times, and distances between vehicles and points of conflict, you will understand the importance of giving signals early to prevent traps, rather than late to escape from traps.

20. Courtesy signals: Occasionally you may slow down and mo-

tion a driver on a cross street to precede you through an intersection, a driver meeting you to turn left in front of you, or a driver in a driveway to enter traffic ahead of you. You should be sure that the driver will not endanager other vehicles or pedestrians before you give such a a signal. For example, if you are in the inside lane of a four-lane street and you motion a driver to turn left in front of you, he might collide with a car overtaking you in the outside lane. Unless you know the way is clear, you should not give such a signal. The other driver may be a novice at the wheel or may have poor vision. He may depend on your signal instead of checking traffic properly.

21. Use of horn:

a. You may use the horn in overtaking and passing a vehicle on the left if you need to signal the driver to give way in his lane and not to increase his speed.

b. You must use the horn when necessary in exercising due care to warn any child or any confused or incapacitated person upon a roadway.

c. You must use the horn upon approaching within 200 feet of a curve along a highway in mountains or through defiles or canyons if your view around the curve is obstructed.

d. You must use the horn when necessary to insure safe operation of your vehicle forward or backward at any time upon a highway.

e. You must not use the horn for other purposes upon a street or highway. It is technically illegal to blast your horn as in a celebration spree. Actually, however, the misuse of the horn disturbs the peace most when it is blasted to signal persons in a residence. Such horn blaring is a nuisance in daytime. Late at night or around daybreak it becomes a serious offense against the peace of a neighborhood.

f. Sounding your horn lightly to alert a slow starter at a signal light is permissible since the driver would be illegally obstructing the lane of traffic. On the other hand, blaring the horn in a traffic jam created by mere volume of traffic or by an accident would be an improper use and could constitute a disturbance of the peace.

g. Use of the horn as a noise maker has been condemned so much that proper instruction in its legal use has not been positive enough. The result is that many drivers neglect the horn as a defensive driving aid. The horn is the simplest control on a car to operate. Barring the steering wheel it is the most convenient control to operate. It is the only audible signal a driver can give. It should not be used illegally but when it is needed it should be used and it should be used early. While the horn may be used in conjunction with braking, steering, and other signaling, it should never be used as a substitute for one of these controls. When a driver senses any need for asking another driver to stay put in his lane, remain stopped at the curb or on a shoulder, or to yield at an intersection, he should signal that driver with his horn. At night blinking the headlights often proves an additional aid but is not a substitute. A driver has not done everything he can reasonably be expected to do to prevent a collision unless he has warned the other driver or a pedestrian with the horn. The next important thing is to warn the other driver early so that he will have time to react to the signal and take proper action. It is not enough to blast the horn after both drivers are committed to an inevitable collision. The instant a driver sees that a trap might develop he should consider using his horn. The earlier a driver uses the horn the less likely it is that he will have to blast his horn and the less likely that the other driver will become confused. However, a blast of the horn might be necessary in an emergency such as waking up an oncoming driver who apparently is asleep.

22. The turn signal law requires a driver to give a turn signal continuously for at least the last 100 feet traveled by the vehicle before turning. A driver leaving a parallel parking zone could not comply with the distance requirement of the turn signal law. In such instances the driver should give the turn signal for at least a minimum of five seconds before pulling out. The student should understand that the law regulating the starting of a vehicle from a stopped, standing, or parked position places full responsibility on the driver when it says that he shall not start unless and until such movement can be made with safety.

23. A turning movement without a forewarning signal may create a mental hazard for another driver and cause him to panic or alter his course in such a way as to endanger himself and others, even though the driver turning is not close enough to the other driver to be in danger of physical contact with the other driver's vehicle. It is important, therefore, that students understand ways in which a turn or a change in direction might affect other traffic. The purpose in requiring a turn signal for 100 feet is to give another driver who might be afrected time to react to the impending change in the traffic pattern, to make a decision to alter his direction or speed, and to warn still another driver of his decision.

TRAFFIC SIGNS, MARKINGS AND SIGNALS

1. **Signs**

a. Octagon: Stop. Then after looking in both directions proceed only if way is clear and every approaching vehicle is far enough away that its rate of approach does not constitute an immediate hazard. This sign may be located on the left side of the roadway at some intersections.

b. Diamond: Warning that a condition ahead constitutes a hazard. The curvature of an arrow on this sign indicates the

amount of bend in the road. Markings indicate the angles at which two roads join.

c. Round: Railroad crossing. (Also indicated by X-shaped cross buck, a gate lowered across the roadway, a flashing red light, a swinging disk, or a stop sign held by a flagman.)

d. Square or rectangular: Information or direction, such as state highway route markers. (A U.S. highway route marker is shaped like a shield.) Also regulations such as one-way streets, speed limits, and parking or turning restrictions. Regulatory signs may be suspended over a traffic lane. Usually, an information sign is a rectangle with the long dimension horizontal, while the regulatory sign is a rectangle with the long dimension vertical.

e. Triangular: Yield right-of-way to any vehicle close enough to constitute a hazard or to a pedestrian using the crosswalk. This sign may be located on the left side of the roadway at some intersections.

2. Markings on Roadway

a. A yellow dashed centerline tells you of two-way traffic moving in opposite directions. Vehicles may be passed when it is clear and safe to do so.

b. A solid yellow line on your side of the road marks a no-passing zone.

c. A dashed white line separates one-way traffic moving in the same direction. You may cross these lines with caution whenever necessary.

d. Parking Zone Lines: Restrict parking area. Do not park with any part of the body or load of your car on or above these lines.

e. Lane arrow: Instructs driver how he may proceed in a lane where the arrow is painted.

3. Signal Lights

a. Red light: Drivers must stop and forward movement is prohibited. Right turns, or left turns in the case of intersecting one-way streets, are permissible after stopping and yielding to pedestrians and vehicles lawfully using the intersection provided there are no signs at the intersection prohibiting such actions.

b. Yellow light: Warning that a red light will appear immediately and that cross traffic may obstruct your lane. Prepare to stop before entering the intersection. If you are close to the intersection when this light shows, you may proceed **only if** you can enter the intersection before the red light comes on.

c. Green light: Proceed, except you must yield to a driver or a pedestrian who was lawfully within the intersection or an adjacent crosswalk at the time the green light came on.

d. Yellow flashing light: Caution. Slow to a speed that will permit you to avoid a collision with a vehicle on the cross street. Caution is prudence in regard to danger. Prudence is wisdom put into practice.

e. Red flashing light: Stop. Then proceed if you do not have to yield to cross traffic or pedestrians using the crosswalk.

f. Green arrow and red light: Proceed only in the direction the arrow points, provided you yield to vehicles and pedestrians already using the intersection legally.

g. Green arrow alone: Proceed only in the direction the arrow points. If a green arrow is suspended over a lane, it directs traffic in that lane only.

h. Walk - Wait pedestrian signal: Comply with instruction facing you when you are ready to step from the curb into a crosswalk. If the WAIT signal shows after you start across, a lag in the vehicular signal light will hold traffic long enough for you to get across.

4. Officer signals: Supercede regulations indicated by traffic control devices. Comply with an officer's directions even though the directions conflict with signs, signals, or pavement markings. An officer on point control where engineering traffic control devices are operating supplants mechanical controls with manual signals in order to move abnormal traffic volumes which tax mechanical controls or to provide breaks in traffic for emergency vehicles or funeral processions.

5. If a traffic control sign, signal, or marking is to become useful to a driver he must associate its meaning with a specific act. The act necessary may be to slow down, to look carefully to the right or left, to check the rearview mirror, to give a signal, to change position in the roadway, to lower or raise the headlight beam, or to increase the following distance. A combination of these acts may be necessary. Signs, signals, and markings are expensive to install and maintain. Their locations, sizes, colors, and shapes are based on extensive research and experience. They are in-

valuable aids to safe driving. To become a defensive driver you should understand the meaning of signs, signals, and markings, you should look for them habitually, and you should discipline yourself to react to them intelligently. When you do these things you will find that it is easier to drive safely.

APPLYING BRAKES ON AUTOMOBILES

1. Methods of Applying Brakes

a. Locking wheels in emergency stop. This method is undesirable because:

(1) It can burn rubber in spots and thus throw a wheel out of balance.

(2) It causes complete loss of directional control.

(3) It can cause a spin and overturn if brakes are not equalized.

(4) It may start a spin if the front wheels are turned or if the road is wet.

(5) It can throw unsuspecting passengers forward (equally dangerous at all speeds).

Under a condition of impending collision (which frequently is a result of inattention to roadway or of poor planning) locking wheels becomes necessary, and all drivers should be conditioned to apply brakes hard as an act of last resort to avoid striking a fixed object, a vehicle, or an animal.

b. Pumping the pedal smoothly in routine deceleration. This method is desirable at speeds above 20 mph because:

(1) It allows the engine to aid in dissipating the kinetic energy of a moving car and therefore prevents unnecessary wear of brake lining.

(2) It eliminates the chance of involuntary locking of front brakes at high speeds, which can cause loss of directional control and overturn.

(3) It signals intermittently with the stoplight to warn a following driver you are slowing or stopping.

(4) It aids in preventing "fading" of brake linings, any of which will fail temporarily if they get hot enough, as in prolonged application of brakes on long hills or mountain roads.

On dry or wet roads the pumping action should be smooth and usually slow; the car should not rock. On ice the pumping action should be rapid with complete releases between applications of brakes.

c. One continuous application of brakes. This method is desirable:

(1) At speeds under 20 mph because there is not enough time to pump the pedal and it permits better control in bringing a car to a stop at a desired point.

(2) On snow if brakes are applied gently, but if wheels start sliding the procedure for ice is better.

(3) To reduce speed quickly a few miles per hour from any speed the car may be traveling.

2. Braking Procedures

a. In normal braking, method "b" should be used until the speed of a car is under 20 mph and method "c" should be used to spot stop the car. However, at any speed method "b" should be changed to method "c" at any point a driver thinks he must stop or slow down quickly.

b. In normal braking by methods "b" or "c," the clutch should not be disengaged until the speed is around 12 mph. There are exceptions to this rule. An example is when a driver wants to flash the stoplight quickly at low speeds under 20 mph to warn traffic to the rear that he will slow down, as for a right turn, and he does not want the engine to slow his speed while approaching the turn. He can get out of the line of traffic faster by disengaging the clutch and regulating his rate of deceleration with the brake.

c. If your car is equipped with overdrive, you should use conventional drive in urban traffic so that the engine can better brake the car when you release the accelerator.

d. Every student should be conditioned to a locked wheel stop by observing a demonstration of one and by making one himself at low speed. He may need to make several quick stops during his first year of driving before he gains sufficient experience in recognizing hazards and using his brakes early enough for normal braking. Furthermore, he needs to know how hard he can appy the brakes without locking the wheels. He should learn to ease up on the brake pedal to unlock the wheels and regain steering control after he has involuntarily locked them, especially in a situation where regaining steering control is more important than the shortest braking distance, in avoiding a collision. If he should lock the wheels at high speed and discover that the car is going to skid into opposing traffic or into a fixed object, he would need to relax the brakes for a second, change the path of the car, and relock the brakes. Knowing this procedure may help prevent panic in an emergency. Panic prevails usually because a driver does not know what to do. In emergency stops the clutch may not be disengaged depending on which way is easier for a driver to appy the brakes hard in the shortest time.

3. Braking Hazard to Occupants

a. In a locked brake emergency stop the force with which passengers will be thrown forward depends on how fast the retarding force is applied to the car. Once the brakes are locked, the f value of the pavement determines the retarding force. The retarding force is expressed in percent of a car's weight and is fairly constant regardless of the speed of the car.

b. Drivers who permit children to stand in car seats may not realize that the children are in as much danger at 10 mph as at 60 mph if the drivers should have to lock their brakes. A deception stems from a driver's sense that tells him the danger difference is comparable to that of hitting a fixed object at 10 mph and at 60 mph. In the latter instance the passenger's forward motion, with the car, at 60 mph is 6 times as fast as at 10 mph. If the car hits a fixed object the energy that must be dissipated instantly is 36 times (6^2) as great as at 10 mph.

But the danger of throwing a passenger forward, due to hard braking only, is created by the retarding force in percent of the vehicle's weight which the brakes can exert. The forward speed of the passenger is relative to the forward speed of the car. The forward speed of the car during braking is 6 times faster at 60 mph than at 10 mph and the distance the car will go while braking at 60 mph is 36 times greater than at 10 mph. If the brakes will lock on a pavement with an f value of .6, the rate of deceleration will be 19.2 feet per/sec/sec (.6 x 32, gravity). The rate will be practically the same at any speed the vehicle is moving.

After the passenger is thrown forward, his body's speed and the distance in which his body stops (relative to the ground) determine the force exerted on his body. There is a tremendous increase in this force if the stopping distance remains constant as the speed increases, as in hitting a fixed object at different speeds. However, as long as the stopping distance is determined by the brakes only, the force exerted will remain constant **because the braking distance increases in proportion to the increase of the square of the speed.** This law of motion in one way is one of the grave hazards of the automobile. In another way it is a lifesaver, because if it were not so and the braking hazard to passengers increased with the speed, passengers would be flung all over the interior of the car everytime the driver applied the brakes hard at 60 mph. As it is, a passenger has to brace himself the same amount to stay in his seat at 60 mph as he does as 10 mph, if the braking effort is the same at the two speeds.

c. The force acting on the passenger is measured in units of gravity. To find the average G's acting on the body:

$$G = \frac{mph^2 \times .0335}{s}$$

G is a measure of the added inertia due to a fast change in direction of force on the body. .0335 is a constant s = braking distance in feet

If the brakes are locked at 10 mph on a pavement that will exert a braking effort of 60%, the braking distance will be 5.6 feet (see Kinetic Energy in DPS book on Physical Forces to find braking distance when the braking effort is known):

$$G = \frac{10^2 \times .0335}{5.6} = \frac{100 \times .0335}{5.6} = \frac{3.35}{5.6} = .60\ G$$

(The force exerted is 60% of the passenger's weight)

If the brakes are locked on a vehicle speeding at 60 mph on a pavement that will exert a braking effort of 60%, the braking distance will be 200 feet:

$$G = \frac{60^2 \times .0335}{200} = \frac{3600 \times .0335}{200} = \frac{120.6}{200} = .60\ G$$

(The force exerted is 60% of the passenger's weight)

If a car hits a fixed object at 10 mph and stops in 2 feet:

$$G = \frac{10^2 \times .0335}{2} = \frac{100 \times .0335}{2} = \frac{3.35}{2} = 1.675\ G's$$

(The force exerted is 1.675 times the passenger's weight)

If a car hits a fixed object at 60 mph and stops in 2 feet:

$$G = \frac{60^2 \times .0335}{2} = \frac{3600 \times .0335}{2} = \frac{120.6}{2} = 60\ G's$$

(The force exerted is 60 times the passenger's weight. Note that 60 G's is 36 times the 1.675 G's at 10 mph.)

Here the car stopped in a distance 100 times shorter than with a braking effort of 60% at 60 mph (100 x .60 = 60). The "braking effort" is 60.0 or 100 times greater than when the car stopped in 200 feet with a braking effort of 60% (.60). A "braking effort" of 60.0 is 6000%. The rate of deceleration is 60 x 32 = 1,920 ft/sec/sec, whereas with a braking effort of .60 the rate of deceleration was 19.2 ft/sec/sec.

In each of the first two examples of 60% (.60) braking at 10 mph and at 60 mph, the force exerted on a 100 lb. passenger would be 60 lbs. The force exerted is the product of the G's developed times the weight of the passenger.

In the third example the braking distance is 2.8 times shorter

than in the first example and the G's are 2.8 times greater. The force on the 100 lb. passenger would be 167.5 lbs.

In the fourth example the braking distance is 100 times shorter than in the second example and the G's are 100 times greater. The force exerted on the 100 lb. passenger would be 6,000 lbs.

d. Cornell University Auto Crash Injury Research indicates that what the G force does to a passenger depends upon:

(1) The duration of the force when the passenger hits something.

(2) The size of the body area over which the force is distributed by the object the passenger hits; that is, the pounds pressure per square inch.

(3) The power of the blow; how quickly it was delivered.

The human body can withstand a great force if the force is properly distributed and the duration of the force is short.

If a certain part of a passenger's head should strike a pointed projection on the panel when thrown from the seat of a car going 10 mph the passenger could be seriously injured whether the car stopped in 5.8 feet or 2 feet. This research is aimed at determining how a passenger can be "packaged" in a car to make the three factors favorable to the passenger when a high G force is exerted on his body. Elimination of projections inside a car and the addition of seat belts, the padded panel, the collapsible steering wheel, and knock-out windshields are all ways being tested in research to determine how best to make the factors favorable to drivers and passengers.

These improvements in car design can reduce the severity of injuries in crashes and in doing so may prevent many deaths. The improvements will not prevent collisions; **only the drivers can prevent collisions.** An exception is the aid a seat belt gives in stabilizing a driver's body in turns. This anchorage could give a driver better control of the steering wheel in avoiding a collision.

4. Brake Performance

a. When a driver applies his brakes hard, most of the weight of his car shifts to the front wheels. The better the brakes are, the more the weight that will be shifted. Therefore, in order to obtain the same distribution of braking effort in a hard application that he would have in moderate braking, the front brakes would have to do about 75% of the work done by all four brakes.

b. Such a distribution works nicely during controlled straight ahead braking, but it might prove hazardous under varying traffic conditions, because:

(1) The front wheels would lock more easily in normal braking and prevent directional control.

(2) Front wheel skidding would be aggravated on slippery roads.

Usually an emergency demands both braking and steering control. Brakes should give a high rate of deceleration **without loss of control.**

c. To insure maximum safety in braking control:

(1) Right and left wheel brakes must exert equal retarding forces.

(2) The distribution of braking effort between the front and rear wheels must be proper for the center of gravity of a vehicle and the load carried.

A distribution with the front brakes doing about 60% of the braking provides a reasonably safe compromise. This distribution may not give maximum results in test stops, but on a slippery surface where the danger of skidding is great a fair degree of efficiency is reached without skidding.

d. The Department of Public Safety has a test car on which any brake may be taken out of use by a manual switch. In locked wheel dry road tests at 30 mph, four brakes stopped the car in about 50 feet. The front brakes alone stopped the car in about 60 feet. And the rear brakes alone stopped the car in about 120 feet. With one rear brake cut out the loss of directional control was a relatively minor problem. With one front brake out, however, the car's change in direction was abrupt. The car swung at right angles to the path of travel and sometimes almost reversed directions. Frequently one rear wheel would leave the ground during the swing. These tests point up the importance of maintaining the front brakes in A-1 condition and of having the right wheel and left wheel brakes equalized. If you detect any side pull when you apply your brakes, especially after they warm up, you should have your brakes adjusted. If adjustments do not improve front wheels braking, you should request an inspection of the entire braking system. **No matter how old your car may be, its brakes should be as good as when the car was new.**

e. Weak brakes and high speed in one respect present a common danger. Each is a hazard because it lengthens the braking distance of a car. A car with brakes that can exert only 40% braking effort* will require about 250 feet to stop at 55 mph. If the car's brakes could exert 65% braking effort* it could stop in about the same distance at 70 mph. (These figures are for locked wheel stops; a driver at 70 mph actually would need much more space for a controlled stop.)

Therefore, if you are driving at night at the speed limit of 55 mph in a car that has 40% brakes you are overdriving your headlights just as much as you would be if you were driving at the dangerous speed of 70 mph with good brakes. There are other factors, of course, which make 70 mph more dangerous than 55 mph with weak brakes. This illustration relates only to overdriving headlights.

* % braking effort here refers to the four brakes' retarding force expressed in percent of the car's weight and should not be confused with the percents of distribution of this braking effort on the front and rear brakes.

f. Classification of Passenger Car Brakes:

Excellent: exert a braking effort of 80% to 100%
Good: exert a braking effort of 60% to 80%
Fair: exert a braking effort of 52.8% to 60%
Illegal: exert a braking effort under 52.8%.

If the brakes are locked at speeds over 20 miles per hour, the rear wheels tend to lock first and begin skiddling because of the weight shift to the front wheels. The front wheels are still rolling. The rear end will try to catch up with the front end and the vehicle will spin a full 180 degrees. The vehicle will be going down the road backward. This is why many drivers lose control of a car when locking their brakes in a panic situation.

BLOWOUT HAZARDS AND RECOVERY PROCEDURES

1. A blowout on a front tire "steers" the front wheel away from the path of the car's center of mass. The retarding force of the blowout tire causes the center of mass to swing forward around the blowout wheel, which acts as a pivot. As the center of mass goes forward, the lateral distance between the pivot wheel and the center of mass becomes greater. The farther back the center of mass is (as with a heavily loaded trunk), the greater the lateral distance between the pivot wheel and the center of mass becomes as the center of mass moves forward abreast of the pivot wheel. The greater this distance becomes the more difficulty a driver will have in preventing the car from changing ends.

Once the pivot wheel and the center of mass are moving side by side down the road, the car is in a spin from which the driver cannot recover. The blowout wheel will fall behind and tend to follow the center of mass. If the car's momentum is not too great, the car will come to rest headed in the opposite direction. If the car's momentum is too great the car will roll over. The momentum is equal to the car's weight times the car's speed.

Before the blowout, a driver can take some precautions. He can avoid overloading the rear end, which moves the center of mass back and makes the car unstable. The average passenger car is overloaded if the car, passengers and luggage exceed a weight of 1,100 lbs. per tire. This load is too heavy for many cars and tires. If a driver must overload, he can reduce his cruising speed to decrease momentum. He can keep good tires on the front wheels and whenever a front tire hits an object which might break threads in the tire's carcass, he can have the tire removed and checked. He can keep his speed within legal limits and his tires properly inflated in order to prevent overheating of the tires. He can drive with both hands on the wheel and his body and legs in an alert position in order to reduce reaction time after the blowout. If a driver's grip is weak or if his reaction time is slow, he can at least keep good tires on his car and his speed under 50 mph. Driver panic due to noise may aggravate blowout hazards. **A driver can condition himself against panic.**

After the blowout, a driver's first job is to steer against the pull in order to keep the center of mass behind the blowout wheel. He must do this quickly and firmly. While it may not hurt to apply the brakes slowly, hard braking may aggravate a potential spin unless the driver can keep the pivot wheel ahead of the center of mass. Locking the brakes will cause him to lose all steering control and might cause the car to skid across the centerline into opposing traffic. Steering is the main thing he must keep doing. To point up the error of overbraking it can be said that a situation might justify even using the accelerator for an instant if a force exerted by the rear wheels would keep the blowout wheel ahead of the center of mass or keep the car on the right side of the road. Accelerating could prove dangerous, however, if it is started after the car is getting crosswise of the road. Accelerating then might aggravate a spin. Accelerating or braking would be safer going upgrade than downgrade. Accelerating is recommended only when it would help avoid a head-on collision.

The most likely driver error in a front tire blowout is failing to steer firmly against the pull to keep the car headed in the same general direction. If a left front tire goes out, keep the car on the right side of the road. In fact, you should try to steer it onto the shoulder. If a right front tire goes out, the car will be on the shoulder before long. You should try to keep it from going into the ditch.

2. A blowout on a rear tire starts a pendulum motion of the rear end. The flat tire will create a drag force which originates behind but to the side of the center of mass. The "dragging" tire will try to assume a position between the two front wheels. But the center of mass likes this place also. All the driver has to do is to steer as nearly straight ahead as he can, keeping to the right side of the roadway, and let the flat tire and the center of mass fight it out. The driver's first responsibility is to steer clear of the path of other drivers.

Ordinarily, braking slows the front wheels most. A car's motion is more stable when the rear wheels are turning more freely than the front wheels. Locking the brakes while the rear end is in a swing might cause trouble, however, because if the swing is to the right, say, and the driver has just oversteered to the left when the

brakes are locked, the rear end might keep going right, as it would under similar steering and braking without a blowout.

The main danger in a rear tire blowout is oversteering—turning the wheel too far to compensate for the whip of the rear end. The front wheels turn hard in a front tire blowout. They turn easy in a rear tire blowout. The driver should condition himself mentally to the rear end's swinging and avoid jerking the steering wheel from side to side. First, keep the car headed straight ahead and then ease it off onto the shoulder.

3. There are two schools of thought on blowouts, the front tire school and the rear tire school. The argument is academic if the speed is too high for directional control.

PASSING PROBLEMS ON TWO-LANE CITY STREETS

1. If the speed limit is 30 mph, it is barely possible to overtake and pass a car going 25 mph within a 300 foot block. In order to make a legal pass, you must start the pass at the exit crosswalk of the intersection, going 30 mph. In a 300 foot block you have only 200 feet in which you can legally drive on the left side, since the law prohibits your driving on the left side within 100 feet of an intersection on the approach side.

2. If the rear of your car going 30 mph (44 ft/sec) crosses the centerline as you leave an intersection and the rear of your car crosses the centerline again 200 feet beyond the intersection, your car will have been on the left side 4.545 seconds. A car you are overtaking and passing that is going 25 mph (37 ft/sec) will travel 168 feet in 4.545 seconds. Since you must go around the length of the car (18 feet) the car will occupy a distance of 186 feet (168 plus 18) during the pass. This leaves a total clearance space of 14 feet (200-186) between the two cars, 7 feet at the start of the pass and 7 feet at the end of the pass. This would be a tight squeeze, but it serves to illustrate the passing problem.

3. It is important, first, that you start passes in city traffic just as you leave an intersection and, second, if you are driving less than 30 mph, that you slow down under 25 mph just as you leave an intersection to cooperate with a driver who is trying to pass you. Incidentally, if 25 mph is the top safe speed for you, you should not exceed it, but it would be discourteous to drive at 25 mph on a two-lane two-way street where 30 mph would be safe for most drivers. This is when you should help drivers overtake and pass you. (Keep in mind that 25 mph is the top safe speed on many city streets.)

If other vehicles behind you are trying to go 30 mph you should either increase your speed to 30 mph or reduce your speed to 20 mph for a few seconds just as you leave intersections to permit the vehicles to feed past you. After you let vehicles pass, you should increase your speed again to 25 mph (if it is unsafe for you to go faster) until you reach the next intersection, where you can drop back to 20 mph and let other cars pass.

4. Do not slow down, however, until you are at a place where a break in opposing traffic will permit the driver to take advantage of your courtesy. The place that would help him most is just beyond an intersection you are leaving. Therefore, when you slow down you should be leaving an intersection, the left side should be clear, and the driver behind should be ready to start his pass. If any one of these three factors is missing, your slowing down will only congest traffic.

5. Where considerable curb parking space is not occupied, it may be possible for you to reduce your speed to 20 mph and drive near the curb for a few seconds in midblock to let a vehicle overtake and pass.

6. The important thing is that if your habitual pace is 25 mph you should not sit there, habitually ignoring other drivers, and congest traffic every time you drive your car. Drivers who pull this stunt are not necessarily selfish intentionally. They do not realize what they are doing. They lack the imagination to reason from the positon of the other driver or they do not possess the skill to blend with traffic. Some of them have all they can do to cope with situations ahead. You should keep this point in mind when you are tailgating one of them. It will help you be more tolerant and it should help you to be more courteous to drivers who want to pass you. Another point: It won't do any good to try to push them along by driving too close. You endanger yourself. They may not even know you are there. It is far better to stay back a safe distance and tap your horn lightly to alert the driver ahead. If the driver is very young or very old it is still better just to stay back. If he speeds up he may involve you in a collision.

7. If you are trying to overtake and pass a slow vehicle, you should time a signal with your horn so that after the driver ahead reacts to your signal and slows down, his car will be at the point most advantageous for you to pass. If the driver ahead of you is willing to slow down but does not want to drive faster (and some should not), you will be wasting your time honking your horn when the left lane is occupied or when you could not make a legal pass if he did slow down. If you conclude the driver ahead should not drive faster or that he will not, you should time your horn signal so that he can slow down either as he leaves an intersection or as he approaches an open curb space. Otherwise your horn blowing will not help you make a legal pass.

Before you try to pass a car that is going under the speed limit, consider traffic conditions. It may be that the limit is too fast for conditions and you may be the only driver on the street trying to drive at the limit. If this is the situation you may be the traffic hazard instead of the driver who is driving under the speed limit.

If you start a pass and find tht you misjudged horsepower, speed, and/or distance, a decision you must make is whether to get back onto the right side behind the car you are passing or to exceed the speed limit in order to complete the pass before you run out of legal distance.

If a vehicle is meeting you, the decision becomes even more urgent. You then have to decide whether to fall back to the right side, to speed up in order to clear the lane before reaching the meeting vehicle, or to make an emergency stop in the left lane to reduce the likelihood or severity of collision.

Since speeding up will increase the hazard, the best procedure is to return to the position from which your poor decision was made. If the driver who was behind you is sharp, he may have foreseen you would be back and may have left your space open. If he failed to do this and other traffic to his rear prevents him from reopening the space for you, you are locked out from this escape.

If the lane is wide and the meeting driver is slowing down and steering close to the curb or parked cars, you might blast your horn to alert the driver on your right and reduce your speed quickly. If the driver on your right gives way, you might squeeze out of the trap by holding to the middle of the street. If the width of the street or the actions of the other drivers do not make this escape possible, there are only two remaining outs.

One is to make an emergency stop so as to reduce the energy of your car as quickly as possible in order to reduce the severity of the impending collision. The danger of this procedure is that you may lock your brakes and skid your car out of control. The other out is to accelerate quickly to complete the pass before you reach the meeting car. The danger of this procedure is that the energy of your car increases in proportion to the square of the increase in speed. It is a case of increasing the hazard rapidly as you increase your chances of escape. If you make it out, the escape is no better than the one through an emergency stop, should the stop prevent a collision. However, if you fail to make it out, the resulting collision may be many times more severe than a collision resulting from an emergency stop.

Since stopping in the wrong lane in the face of a meeting vehicle, whose driver has all of the rights, may be both embarrassing and terrifying, you may be inclined to make a run for it, even when there is no chance of success. This tendency has pushed many a driver to an untimely death, in the company of his innocent victims.

The purpose of the above analysis is to condition you to aspects of the serious traffic hazard you can create by starting an unsafe pass. The possible escapes discussed are in no way related to defensive driving procedures. The defensive procedure is to stay in line when in doubt. Do not start a pass unless it can be made safely.

TRANSITIONS BETWEEN ROADWAYS CONTAINING DIFFERENT NUMBERS OF TRAFFIC LANES

1. A transition is a situation where two lines of traffic moving in the same direction must blend into one line of traffic. The situation occurs at junctions of roadways containing different numbers of traffic lanes. A special case and one which is extremely hazardous is a bridge in a roadway containing more lanes than the bridge.

2. When you approach a transition you will usually have advanced warning by signs such as **Divided Highway Ends, Pavement Narrows, Narrow Bridge, One-Lane Bridge, Two-Lane Bridge.** Usually pavement transition markings will guide you when you reach a transition. A two-lane roadway may become a multilane roadway over the crest of a hill. The transitions here may be indicated by pavement markings also. Reflectorized delineators on a shoulder may guide you at a transition.

3. When you see a sign warning you that a transition is ahead, adjust your speed immediately. Always check traffic in your mirror and in the adjoining lane and prepare to give proper signals. If you are in the lane that continues beyond the transition, expect a driver in a lane that ends to move suddenly into your lane. You should allow room for such drivers ahead of you in the adjoining lane and allow them to blend into the traffic in your lane.

If you are in the lane that plays out you should flash your stoplight and start slowing immediately after seeing the transition warning. Do not delay taking these precautions. If more than one vehicle is close behind you, give a hand and arm slow signal in addition to the stoplight signal. If traffic is heavy in the through lane, every vehicle in your lane may have to come to a complete stop. If you do not plan and act early the end of your lane may have to come to a complete stop. If you do not plan and act early the end of your lane may be the end of you, or the transition may transform your beautiful, smooth-running automobile into an unsightly mass of crushed metal. It all depends upon your habit of reading the signs and your discipline to take proper action early.

SMALL BARRICADES IN ONE LANE OF A MULTILANE ROADWAY

When your lane is barricaded by small cones or a sawhorse you are headed for a trap. Before changing lanes you must give a turn signal for 100 feet if other traffic may be affected, and you must check the other lane to see that a vehicle overtaking you is not near. If changing lanes might endanger traffic you should come to a stop. To do this safely you should flash you stoplight immediately because your car may hide the cones from drivers behind you. If several cars are behind you, give a hand and arm stop signal also. A driver who barges up to the barricade without taking these precautions should have stayed at home.

USE OF REARVIEW MIRROR IN APPROACHING AN INTERSECTION

1. The rule to check your mirror every few seconds involves special timing in city traffic. On city streets make a routine check of the mirror at least once between intersections, preferably at midblock. Traffic conditions may require checking the mirror at various places, but immediately after starting up on a green light

in traffic you may need to concentrate on your distance from the vehicle ahead. Vehicles accelerating at different rates increase the danger of collision at this point.

2. If at midblock you see there is no traffic behind you near enough to create a hazard for you at the next intersection, you can then give your full attention to the intersection.

3. If at midblock you discover that the position or speed of a vehicle (or vehicles) behind you might create a hazard in case you have to brake or swerve suddenly at the next intersection, you will have time and distance to signal properly and to alter your speed and/or lane position before you get too near the intersection. You may need to check again to see whether your signals (hand signal and/or flashing stoplight) have alerted the driver(s) behind you.

4. You should do all of your mirror checking before you are within 80 feet of the intersection. You should give your full attention to the intersection area thereafter. If you develop the habit of looking in the mirror after you are within 80 feet of an intersection you are headed for trouble, because you may be going into the intersection "blind." At 30 MPH you certainly will be going into the intersection "blind."

5. At 30 MPH you are traveling 44 feet per second. If you check the mirror at a point 80 feet from the intersection and it takes you ⅓ second, you will be 58 feet from the intersection when you look back at the cross street. If you then see a hazard that requires emergency braking and it takes you ¾ second to hit the brakes, you will be 25 feet from the intersection when the brakes lock. At 30 MPH you car will skid 48 feet, or 23 feet into the intersection. You would collide with a vehicle in your path in either lane of the cross street. Suppose you move your foot to the brake pedal when you check the mirror and thus reduce your reaction time from ¾ second to ⅓ second. In ⅓ second you will travel 15 feet and be 43 feet from the intersection when your brakes lock. Your car will still skid 5 feet into the intersection. If a vehicle coming from your left were in your path you would collide with it. You cannot, therefore, maintain control of your car at 30 mph if you check the mirror after you are within 80 feet of an intersection. (This problem is based on braking with 4 locked wheels on a pavement with a coefficient of friction value of .62, a fair average for worn asphalt.

6. If in the midblock check you discover a developing traffic situation that might trap you at the next intersection and you immediately give proper signals and reduce your speed to 25 mph, by the time you are 80 feet from the cross street, you will barely have time to check the mirror again and stop your car before entering the intersection (18 ft. to check mirror plus 28 ft. to lock brakes plus 34 ft. skid distance = 80 ft.). But you could not do it at 30 mph. You must either do your last mirror checking before you are 80 feet from an intersection or you must reduce your speed to 25 mph by the time you are 80 feet from the intersection. Otherwise, the other drivers must take care of you, and the purpose of this course is to analyze the ways in which you can take care of yourself and help take care of the untrained drivers.

7. It might seem that when speeding at 60 mph on the approach to a rural intersection you would merely have to double the distances in the city problem, but this is not true. Suppose you have just completed the mirror check when you are 160 feet from an intersection. If it takes you ¾ second to hit the brakes you will be 94 feet from the crossroad when the brakes lock. Your car will then skid 194 feet. Even if you shift your foot to the brake pedal when you check the mirror, making your reaction time ⅓ second instead of ¾ second, you will be 131 feet (instead of 94 feet) from the crossroad when your brakes lock, but you will still have 194 feet to skid. You will have 63 feet more to skid after you reach the crossroad and you will be skidding at a speed of 34 mph when you enter the crossroad.

The following equation will show the speed you will be skidding when you reach the crossroad:

$v = \sqrt{u^2 - 2as}$

$v = \sqrt{7744 - 5240}$

$v = \sqrt{2504}$

$v = 50$ ft/sec

$v = 34.1$ mph

v = speed in ft/sec after skidding 131 feet

u = initial speed (88 ft/sec at 60 mph)

a = rate of deceleration (20 ft/sec/sec when f is .62 and 4 wheels are locked)

s = distance to crossroad from where you locked the brakes (131 ft.)

8. To stop short of the intersection at 60 mph you will have to be 304 feet from the crossroad when you check your mirror last (44 ft. to check mirror, 66 ft. to react and 194 ft. to skid). If you reduce your reaction time from ¾ second to ⅓ second by moving your feet to the brake pedal when you check the mirror, you will have to be 267 feet from the crossroad (44 plus 29 plus 194).

9. In these problems it should be noted that only ⅓ second is allowed for checking the mirror. This is only half the time it takes you to say "1,001." To check the mirror in ⅓ second the car seat and mirror must be so adjusted that you have to move only your eyes, not your head. If you have to move your head, you had better refigure the problems using 1 second for checking the mirror. If you have to move your body, allow 2 seconds.

In the time allowed to check the mirror you can determine only that an object is behind you, close or far. You cannot try to estimate its rate of overtake. If you do this, the minimum time and distances for checking the mirror in these problems will have to be increased accordingly.

10. It is not enough to be convinced that 80 feet (at 25 mph) and 219 feet (at 50 mph) are the minimum safe distances from an intersection for checking your mirror. You must learn to recognize these distances on the ground. If, after you learn to recognize these distances on the ground, you will practice checking your mirror before you enter these areas, you will develop an important

habit that will help keep you out of intersection traps. If you do not develop a habit of timing your actions to enable you to cope with speed-distance problems at intersections, you will not develop into a defensive driver. There are just too many intersections. Actually a defensive driver would allow sufficient distance to decelerate without locking his brakes.

CHECKING LEFT LANE BEFORE STARTING TO OVERTAKE AND PASS

1. The urgency of looking carefully down the left lane of a two-lane road before starting to overtake and pass cannot be overstressed. If a driver forms a habit of making only quick casual checks as he pulls out to pass, he may be headed for a trap. If there is a slight upgrade ahead sufficient to prevent the top of an approaching car from showing above the horizon and the color of the car blends with the pavement background, even a driver with 20/20 vision may not detect the car until he is in the middle of a pass. This trap can develop on a sunny day, but it is more likely during a shower and during dusk. There is no doubt that this seeing handicap accounts partly for dusk being the peak time of rural fatals. The trap is more deceptive when the nearest car is, say, a brown car on a brownish pavement and a car farther back, up the grade, is of a color that contrasts with the color of the pavement, such as green. The driver checks quickly, decides that the green car is far enough away, and accelerates. His eyes are looking down the lane, but his mind is seeing only the green car because he is working on the problem presented by the green car.

2. Keep this seeing problem in mind when you are in the car that may not be seen by a driver who is about to overtake and pass a vehicle meeting you. Consider the grade you are on, the color of your car, and the color of the pavement. A blue or gray car on a level road with a blue sky as a backdrop creates a similar trap. **If there is any doubt that your car will be seen, you should turn on your headlights.** A driver who runs another car off the road in a pass is not always an "idiot." He may be a victim of the complexities of modern traffic. There are millions of these untrained and inexperienced drivers who have made driving a motor vehicle a constant gamble with injury and death.

THE RIGHT-OF-WAY AND HOW TO SHOW DRIVERS YOU WILL YIELD IT

1. A driver should have a proper concept of the term "right-of-way." Right-of-way is the privilege of the immediate use of the highway by a pedestrian or by one of the drivers of two vehicles when their movements conflict. Drivers of vehicles have equal privileges on public roads, provided they meet licensing and registration requirements, and drive so that they will merit the privilege. The use of a public road is not an inherent right. When the movements of two vehicles conflict, the driver of one vehicle must necessarily yield the immediate use of the highway to the other driver. The other driver's privilege to use the public road is not enhanced. Rather, the yielding driver gives up his privilege to use the area, temporarily. **You can have the right-of-way only when someone yields it to you.** Yielding the right-of-way is a serious responsibility of a driver. A driver should know the situations in which he should yield so thoroughly that he can make correct decisions rapidly in heavy traffic without thinking twice. He should also know ways in which he can inform drivers he intends to yield.

2. When you are waiting at a stop sign, in a private driveway, or in a crossover on a four-lane divided road, you can do several things to inform another driver that you know he is coming and that you intend to yield to him. If you are on his right, you can hold a hand and arm stop signal for him to see. You can deliberately look in his direction to let him know that you know he is there. You can keep your car still with your foot brake to prevent it from easing forward.

When you approach a main highway from a side road you can reduce your speed to about 10 mph at least 50 feet from the highway fence and come to a stop at some point between 50 feet and 15 feet from the highway pavement. If you slow down early a driver on the highway will at least know that you can stop before reaching his traffic lane.

3. If you are waiting on a shoulder or parallel to a curb for approaching vehicles to pass, you can hold a stop signal with hand and arm, or hold the stoplight on, or look back out of the driver's window to let other drivers know that you know they are approaching and that you will wait. At night you can keep your park lights or low beam on until you are ready to move. If you switch on the upper beam early, an approaching driver may think you are about to move into the roadway. Incidentally, you should enter traffic with low beam if a meeting vehicle is within 1200 feet of your car.

4. If you are backing into a traffic lane from a private driveway or from an angle parking zone, and after reaching the traffic lane you decide to wait for an approaching vehicle, you can ease forward a few feet.

If you are about to leave your car on the traffic side, you should of course look back out of the window before opening the door.

5. When you approach the traffic side of a car to enter it or for any other purpose always look toward an approaching driver to let him know that you are aware of him. If the approaching driver is near, you can stop either in front of or behind the car, look toward the approaching driver and motion him on. Incidentally, if traffic is heavy and a high curb prevents you from entering on the curb side, you should stand close to the car just behind the door handle and open the door just enough to slip in sort of sideways. If two people need to enter a car in this manner one should stay in front of or behind the car until the other one is inside. There will then be one to give first aid in case the other one is injured during this unsafe entry.

6. When you are behind a car in an outside lane, planning to

overtake and pass the car, and you wish to wait for a car coming up on your left rear in the inside lane, you can cut off your left turn directional signal and either give a hand and arm slow signal or motion the driver to come on by. If you are the driver in the inside lane and you wish to yield to the driver in the outside lane who wants to overtake and pass the car ahead of him, you can decelerate slightly. He will then probably look to the side to check your car and you can motion him to enter your lane.

7. When you are making a U-turn and you decide to yield to an approaching vehicle, you can give a hand and arm stop signal and hold your stoplight on.

8. When you turn right into a clear outside lane of a four-lane street and traffic is approaching from your left in the inside lane, you can keep your car close to the right side of the outside lane as you enter it. This precaution will help inform a driver in the inside lane that you do not intend to go into his lane.

9. You should be certain that you are not exposing a driver to conflict with another vehicle or a pedestrian when you motion him to proceed. When a driver motions you to proceed, look for another vehicle or a pedestrian who might be in your path. A driver or a pedestrian who motions you to proceed is merely telling you that he will yield. He is not directing traffic and is not responsible for clearing your way with other persons. When you motion a person to proceed and he hesitates, remember that he may see hazards which you do not see. If you decide to wait when a person motions you on, you can let him know immediately by motioning him to proceed.

YIELDING RIGHT-OF-WAY TO EMERGENCY VEHICLES

1. Ambulances, law enforcement vehicles, fire department cars and trucks, and voluntary firemen in private vehicles responding to emergency calls are classified as emergency vehicles.

2. When an emergency vehicle which is either sounding a siren or is displaying a red light on the front approaches on a two-way street, drive as far to the right as you can and stop. On a one-way street, go to the nearest curb. If you are unable to get to a curb because of other vehicles, stop where you can leave a passage open and remain stopped until the emergency vehicle has passed. After the emergency vehicle has passed make certain that no other emergency vehicle is approaching before you proceed. Always leave a path open for the emergency vehicle and try to do this without stopping in an intersection, where you might obstruct turning space needed by a big vehicle. You should yield the roadway whether the emergency vehicle is approaching from the front or the rear and whether on a rural highway or on a city street. Once you have stopped and a way is clear do not move your car after the emergency vehicle is within a block of you on a city street. Stay where you are. The emergency driver will steer around you.

3. If you close up your car tight and turn on your radio in city traffic, you might fail to hear a siren and drive into the path of an emergency vehicle. If you keep a lookout down the road in front and check your rearview mirror frequently, you should not have this trouble on a rural road.

BRAKING DISTANCE CHARTS

1. Organizations distribute for educational purposes various types of charts which show the braking distances of motor vehicles at different speeds. Usually these charts show the reaction time distance based on a selected value for reaction time of drivers and show braking distances based on a selected value of braking effort of vehicles.

2. Any one of these charts will be accurate for large percentages of drivers, vehicles, and pavements. If the coefficient of friction (f) value of a pavement is .60, the effective braking effort of a car's brakes is only 60% even though the vehicle's brakes can exert a braking effort of 80%. A driver who has brakes which will lock the wheels on brushed concrete (with an f value of .90) may question a chart based on a braking effort of 60%. He overlooks the fact that the f value of most of the roads he drives over is nearer .60 than .90. For this reason the braking effort selected for most of these charts (for passenger cars) will lie between 50% and 75%.

3. A 75% chart is not as practical for rural speeds as a 50% or 60% chart, even if the f value of the roads were .75, because the chart distances represent locked-wheel braking. Locking the wheels at 60 mph not only is a difficult task for a driver, unless he is in panic, but also is a very dangerous thing to do because the driver loses directional control of his car. Hard, controlled braking, therefore, at rural speeds will be near a braking effort, of 50% to 60%, even though the braking effort of the car's brakes or the f value of the pavement is higher. Distances shown on charts based on f values around .50 should be learned and respected by drivers.

4. Some people question the charts because "my brakes are better than that." Others think there is only one braking distance for a given speed on any dry road and "this chart shows what it is." The Traffic Committee of the IACP prepared a report to clear up confusion on the subject. A National Conference on Stopping Distance Charts was called by the Association of Casualty and Surety Companies. This conference prepared charts (strictly for **educational** purposes) based on the maximum distances permitted in the Uniform Vehicle Code (which permits different limits for cars and trucks) and adjusted where necessary at higher speeds to conform to studies of the U.S. Bureau of Public Roads. Below are excerpts from the charts. The distances, then, are not what your car or truck might require to stop, but rather what you as a defensive driver can expect of vehicles on the road.

SPEED	REACTION TIME DISTANCE	*BRAKING DISTANCES			
		Passenger Cars	Light 2-Axle Trucks	Heavy 2-Axle Trucks	3-Axle Trucks Combinations
10 mph	11	6	7	10	13
20 mph	22	25	30	40	50
30 mph	33	55	67	92	115
40 mph	44	105	125	165	205
50 mph	55	188	225	255	320
60 mph	66	300	360	370	465
70 mph	77	455			

* These distances are derived under good conditions, good car, good paved road surface, and good brakes. If conditions are not good, braking distances will increase enormously.

5. Add the reaction time distance to the braking distance to get the stopping distance. Perception-time distance, based on the time it takes a driver to see a hazard after he could have seen it, had he been giving proper eye attention to the roadway, actually is a part of the stopping distance, because it may vary from ½ of a second to several seconds. A driver watching the roadway carefully may, the instant he reaches the crest of a hill, see a cow in his lane 400 feet away. Another driver, lighting a cigarette, may not see the hazard until he is 176 feet beyond the hillcrest. A third driver, nodding as he tops the hillcrest, may wake up 352 feet beyond the hillcrest to see the cow 48 feet away. The first driver's stopping distance would not include any perception-time distance. The second driver's stopping distance would include a perception-time distance of 243 feet (3 seconds, if his car were going 55 mph). The third driver's perception-time distance would be 324 feet (4 seconds at 55 mph). This driver would hit the cow during his reaction time, if this time were ¾ second because at 85 ft/sec he would travel 61 feet. If he had nodded one more second and the impact with the cow had stopped him cold, his stopping distance would consist only of perception-time distance. If he does not recover his perception-time is infinity.

Air Force research has shown that the average trained pilot under normal conditions takes a minimum of 3 seconds to perceive and identify a hazard. Using this criteria we can say that it will take a normal driver a minimum of 3 seconds to perceive and identify a traffic hazard. A driver lighting a cigarette will take longer. Any distraction of the driver will lengthen the perception time. On a typical rush hour situation with an alert driver, who is aware of the traffic ahead and has sufficient following distance, the perception time may drop to ½ second because the driver is already aware of the hazard and knows what his response must be if the traffic ahead has to stop.

Using this criteria let's build a chart showing total stopping distance in feet including perception time.

Speed	3 Second Perception Time Distance (ft)	1 Second Decision Time Distance (ft)	Reaction Time Distance (ft)	Braking Distance (ft)	Total Stopping Distance (ft)
10	45	15	11	5	76
20	87	29	22	20	158
30	132	44	33	49	258
40	171	58	44	80	353
50	219	73	55	125	472
55	243	81	60	138	522
60	264	88	66	180	598
70	309	103	77	245	734
80	351	117	88	320	875

VEHICLE ACCELERATION AND DECELERATION

1. Acceleration Table

Acceleration Rate	0.0 mph to 30 mph		30 mph to 60 mph		0.0 mph to 60 mph	
	Time (sec)	Distance (feet)	Time (sec)	Distance (feet)	Time (sec)	Distance (feet)
2 ft/sec/sec. (1.4 mph/sec.)	22	484	22	1,452	44	1,936
4 ft/sec/sec. (2.7 mph/sec.)	11	242	11	726	22	968
6 ft/sec/sec. (4.1 MPH/sec)	7.33	161	7.33	484	14.66	645

2. It is important that a driver be aware of the time and the ground distance that it takes (1) for him to pick up speed when he enters a traffic lane in front of an approaching vehicle and (2) for a vehicle, which enters the traffic lane in front of him, to pick up speed.

3. When an accelerating car with automatic shift goes from low gear to second gear to high gear, its rate of acceleration changes considerably. A car in low gear can accelerate much faster than 6 ft/sec/sec. for a short distance. You should use low gear to accelerate quickly for short distances, such as in getting across a busy highway or in making room for a vehicle overtaking your car fast just after you enter a traffic lane from a stop. In the latter case you may need to make a quick surge in low gear followed by one in second gear.

4. A good car accelerating from a stop to 30 mph (in second gear at 10 mph and in high gear at 20 mph) will average about 4 ft/sec/sec. It will take 11 seconds and 242 feet for the car to reach 30 mph. If the car is loaded it will take more time and a longer distance.

5. While the car is accelerating to 30 mph in 11 seconds, a vehicle overtaking in the lane at 30 mph will travel 484 feet in those 11 seconds. The vehicle would have to be 242 feet from the point at which the car entered its lane, or would have to slow down, to avoid a rear-end collision. If the vehicle is going 60 mph it will travel 968 feet in 11 seconds and would have to be 726 feet from the point at which the car entered the lane, or would have to slow down, to avoid a rear-end collision.

6. Three problems which constantly plague drivers are (1) the distance required to decelerate a car, (2) the distance required to accelerate a car, and (3) the distance covered by a car moving at a constant speed. If a driver can visualize these distances in traffic patterns he is on his way toward improving his driving judgment. You can detect a need to analyze these factors when you hear accident victims make statements such as: "The driver ahead of me hit his brakes and I didn't have a chance;" "When I started to turn left this guy wasn't even close;" "The car that hit me was a half a mile away when I started around the truck."

7. Deceleration Problems

a. Comparison of the Speed of a Car When Braking Starts, With the Speed of the Car When Half the Braking Distance is Covered. Braking Effort 60%.

Speed When Braking Starts	Half of Braking Distance	Speed When Half of Braking Distance is Covered	Total Braking Distance
80 mph	177.5 ft.	56.5 mph	355 ft.
70 mph	136.0 ft.	49.8 mph	272 ft.
60 mph	100.0 ft.	42.4 mph	200 ft.
50 mph	69.5 ft.	35.0 mph	139 ft.
40 mph	44.5 ft.	28.3 mph	89 ft.
30 mph	25.0 ft.	21.2 mph	50 ft.

Note that from any initial speed a car, after skidding half of the total braking distance for the initial speed, is still traveling at 70% of the initial speed. In other words, when the total braking distance is reduced 50% the initial speed is reduced only about 30%. This relationship of speed and ground distance is deceptive and therefore accounts for the error of driving too fast for conditions.

b. When a driver reduces his speed from 55 mph to 45 mph upon seeing a hazard ahead, he reduces his total braking distance 47 ft. (137-90). When a driver increases his speed from 40 mph to 50 mph he increases his braking distance 45 ft. (80-125). He increases his speed only 18.7% but he increases his braking distance 36%. The way in which braking distance increases with the speed is deceptive and therefore is a hazard of high speed. Very few drivers are aware of this hazard.

c. Exceeding 55 mph just 10 mph adds 58 feet to the braking distance. If at 55 mph a driver should be able to skid to a stop just before striking another vehicle or a fixed object, he would, had he been going 65 mph, strike the vehicle or object at a speed of 34 mph. Fifty-four feet is the braking distance of a car going 36 mph with a braking effort of 60%.

d. A car at 75 mph takes 5.73 seconds to skid to a stop with a braking effort of 80%. The braking distance is 315 feet. In the first second of deceleration the car skids 100.4 feet. In 17% of the braking time the car skids 32% of the braking distance. In one second the car skids nearly one-third of its total braking

distance. The way in which kinetic energy increases, in proportion to the square of the speed, is very deceptive. A driver's common sense might tell him that the distance it takes to reduce a car's speed 13 mph would be the same regardless of the initial speed of the car. In the above example the car's speed is reduced from 75 mph to 62 mph in one second and this 13 mph reduction requires 100.4 feet. If the car's initial speed were only 13 mph the car would stop in 9.4 feet. If a driver's common sense tells him that he is adding only 9.4 feet to the braking distance at 62 mph when he increases his speed to 75 mph, his common sense is deceiving him 91 feet. This 91 feet is the braking distance for an initial speed of 40.5 mph. The driver's common sense is telling the driver that he is adding energy equivalent to an intial speed of 13 mph when he increases his speed from 62 mph to 75 mph, when actually he is adding energy equivalent to an initial speed of 40.5 mph, which creates 9.7 times as much energy as 13 mph ($40.5^2/13^2 = 9.7$).

e. These problems are examples of how knowledge gained through an understanding of subject matter will automatically improve driver discipline. If the instructor merely says high speed is dangerous without showing why, he fails to teach concepts which will motivate self-discipline. If on the other hand, the instructor is able to get the student to visualize the ground distances covered in accelerating and decelerating and the tremendous destructive force one can create simply by pushing the gas pedal, the student's understanding will generate discipline.

FOLLOWING DISTANCES

1. When you speak of safe following distances at various speeds, do you mean by the word "safe" a distance from which you will not collide with the car ahead should its driver lock brakes, or do you mean a distance from which you will not be injured in case you do collide with the car ahead? You probably mean a distance from which you would not hit the car ahead, but the question is asked to point up the fact that once you are following at a distance from which you could not avoid a collision should the driver ahead lock his brakes, the length of this unsafe distance is an important factor in the severity of the collision.

This is obvious, you might add. The closer one follows a car the more likely he is to be injured. You reason thus because you know that the closer you follow, the more likely you are to collide should the driver ahead stop suddenly. The last conclusion is sound, but the first conclusion is incorrect. This apparent contradiction shows how complex driver problems can be and why a driver education teacher should treat acceleration rates and collision forces very carefully when he teaches the unit on physical laws.

2. A minimum safe following distance will vary with individual drivers, because the time required for seeing and recognizing a hazard and for reacting to decelerate or to change direction is one factor which influences both a collision and its severity.

The cruising distance covered during P-R (perception-reaction) time varies with the time: Distance = speed x time. But the braking distance covered during deceleration varies by the square of the time:

$$s = ut - \frac{at^2}{2}$$

s = distance in ft
u = initial speed in ft/sec
a = rate of deceleration in ft/sec/sec
t = time in sec

3. If you are following a car at 55 mph (81 ft/sec) and your P-R time is 3 sec, you will travel 385 feet before you can apply the brakes. If the driver ahead locks his brakes (on an average pavement) he will decelerate at a rate of 20 ft/sec/sec. In 2 sec his car will travel 136 ft:

$$s = (81 \times 2) - \frac{20 \times 2^2}{2} = 162 - 40 = 172 \text{ ft.}$$

If you are following him at a distance of 40 ft you will overtake and hit his car in exactly 2 sec, just as you apply your brakes. He will have reduced his speed to 48 ft/sec since he decelerates for 2 sec at a rate of 20 ft/sec/sec (88 - 40 = 48). This is 32.7 mph. You will be traveling 88 ft/sec or 60 mph. The relative speed at the instant of impact will be 40 ft/sec or 27.3 mph (60 mph - 32.7 mph = 27.3 mph).

In the table below you will note, however, that the relative speed is not a reliable index to the severity of a collision. A better index to severity is the relative energy, which depends upon what the two speeds of the two cars are at the time of collision. Energy increases by the square of the speed. Yet the mechanics of rear-end collisions is too complex for a driver to depend upon relative energy, or time even, as a guide in following judgment. While distance is a more practicable guide, distance itself can be very confusing, as the table reveals.

4. If a driver's P-R time is 3 sec the driver at 55 mph must follow at a distance of 385 ft to avoid a collision in locked wheel stops made by him and the car he is following. This distance is nearly 3 times the driver's speed in mph (3 x 55 = 165 ft).

While 162 ft (2 x 81) is considered a minimum safe following distance at 55 mph it should be made clear to students that this distance allows a P-R time of only 1.36 sec (120/88 = 1.36). If a driver's reaction time is 0.75 sec, he has only 0.61 sec in which to see and recognize the hazard. If his P-R time exceeds 1.36 sec, he will collide with the car ahead because he will get his brakes locked beyond the point at which the driver ahead locked his brakes.

5. As the following distance (at 60 mph) is shortened under 176 ft, the 2.0 sec P-R time overlaps the braking time more and more, and the relative energy increases more and more, up to a point. This point is a following distance of 40 ft. As the following

distance is shortened under 40 ft the relative energy decreases. If you follow at 120 ft you will be trapped, unless you can reduce your P-R time to at least 1.36 sec. As you shorten the distance under 120 ft you have little to no chance of avoiding a collision by locking your brakes, because there is a limit below which you cannot reduce your P-R time.

Therefore, if your poor judgment permits you to follow at a distance of say 80 to 40 ft, you might be better off to follow at 5 ft or less. Of course, the 5 ft position at 60 mph could create panic in the car being following and cause an accident which otherwise would not occur. The driver and occupants in the car being followed very likely would not know that they were in less danger from you 5 ft behind them than they would be if you were 40 ft behind them. The intuition of observers would prompt them to describe your following at 5 ft at 55 mph as a careless or negligent act. The same common sense might tell the observers that following at 40 ft, or 60 ft, or 80 ft is much safer than following at 5 ft. They would be wrong if the driver following depends on locked brakes to avoid a collision.

Since following at 5 ft at 55 mph might cause a collision if Car A should slow down even slightly, the idea is ridiculous. It is discussed here only to show how much more hazardous is the habit of following at 80 to 40 ft at 55 mph, a frequent practice of uninformed drivers on expressways. These are the drivers who keep injured victims of rear-end collisions following one another closely into our hospitals.

6. Note in the table below that at following distances of 40 ft and less the Car B driver (with a P-R time of 2 sec) is never able to apply his brakes. He hits the lead car at 60 mph in every example, except of course when the following distance is 0 rt. With this fact in mind one can see why the relative speed and the relative energy are reduced as the following distance is shortened under 40 ft. The closer Car B is to Car A when Car A locks brakes, the less time Car A will have to reduce its speed before Car B hits it. The smaller the difference between the two speeds of the two cars at the time of collision (when the speed of one car is 60 mph), the less the relative energy will be.

7. This Texas accident is one of many giving evidence that drivers get by with following too close only until something unexpected happens and springs the trap which they have been setting for themselves a long time:

A pickup going north on S 35 blew a tire, swerved across the centerline, and collided with an oncoming station wagon. Another pickup and another station wagon immediately crashed into the wreckage.

The driver of the first pickup was critically injured. The driver of the first station wagon was killed and his wife was critically injured. Eight other persons were injured.

The problem facing the drivers in the second pickup and the second station wagon was similar to one they would face in fog or in a sandstorm where a vehicle ahead is stopped or almost stopped when a driver first sees it. There is no braking distance of the vehicle ahead to make more room for the driver following to stop short of a collision.

As you speed along a highway at 60 mph on a clear day, maintainig the "minimum" safe following distance of 120 ft, keep in mind that if up ahead of you there suddenly occurs an accident which eliminates the braking distance of the vehicle you are following, you will crash into the vehicle just as you would if you were driving at 60 mph in a fog or sandstorm with low visibilty. Your following distance of 120 ft allows you only 1.36 sec for perception and reaction. You will need about 200 ft more for braking. If you are giving close attention to the roadway ahead and your reaction is fast, you might cut down the 1.36 P-R time a little and get in enough braking to reduce your speed a few miles per hour. But if you rely on braking alone you will crash the car ahead at a death-dealing speed.

8. In the accident just described the lead driver had no opportunity to avoid a quick stop. The driver following was the victim of an unusual situation, you might add. Then note what can happen when the lead driver makes a normal quick stop. This is another Texas accident:

"Their car plowed into the rear end of one driven by W- when W--stopped abruptly to help a stranded motorist who was flagging cars for assistance. A-, who was not driving, was thrown against the windshield. A-- was so badly cut up...doctors had to take 500 stitches in his face...doctors worked approximately four and one-half hours on A-. Plastic surgery will probably have to be used later."

While the lead driver in this accident could easily have prevented the collision, his driving error ocurred suddenly. The driver following was cruising in a trap by following too close. Apparently neither driver was capable of recognizing the traffic hazard he created.

9. Following Distance-Collision Energy table:

Car B is following Car A at 60 mph. The table below shows what happens after Car A locks brakes when Car B is following at various distances. The combined perception time and reaction time of Car B driver is assumed to be 2 seconds. Car weights are assumed to be 3600 lbs each for calculating energy. The chart uses 60 mph as a speed to facilitate ease of math equations.

Following Distance	Time for B to hit A	Distance B travels to hit A	Vel of B when B hits A	Vel of A when B hits A	Relative Speed Between B & A	*Relative Energy Involved
176 ft	(no collision — in 2 sec Car B travels 2 x 88 ft and locks brakes at point where Car A locked brakes)					
120 ft	4.000 sec	312.0 ft	32.7 mph	5.5 mph	27.3 mph	124,685 ft lbs
100 ft	3.500 sec	285.5 ft	39.6 mph	12.3 mph	27.3 mph	170,024 ft lbs
80 ft	3.000 sec	254.0 ft	46.4 mph	19.1 mph	27.3 mph	214,578 ft lbs
60 ft	2.500 sec	217.5 ft	53.2 mph	25.9 mph	27.3 mph	259,132 ft lbs
40 ft	2.000 sec	176.0 ft	60 mph	32.7 mph	27.3 mph	303,685 ft lbs
20 ft	1.414 sec	124.4 ft	60 mph	40.7 mph	19.3 mph	233,221 ft lbs
10 ft	1.000 sec	78.0 ft	60 mph	46.4 mph	13.6 mph	173,645 ft lbs
5 ft	0.707 sec	62.2 ft	60 mph	50.4 mph	9.6 mph	127,181 ft lbs
1 ft	0.316 sec	27.8 ft	60 mph	55.7 mph	4.3 mph	59,701 ft lbs
0 ft	(bumper to bumper)	0.0	60 mph	60 mph	0.0	0.0

* For a discussion of relative energy, momentum and impact forces see Physical Forces Affecting an Automobile in Motion, Texas Department of Public Safety.

LITTERBUGS

The citizens of Texas are paying over 9 million dollars annually for the collection of roadside rubbish and trash. As a driver education instructor, you can help reduce this economic waste by:

1. Explaining the problem to your students and urging them not to throw trash on public property and to discourage this practice among their friends and acquaintances.

2. Suggesting to the students that they carry paper bags in their cars to accumulate whatever litter they may have on an extended trip, disposing of such bags in suitable receptacles at rest stops.

3. Promoting a local project to survey your area to determine where additional containers should be placed for collection of litter. Particular attention should be given to points of interest where motorists frequently stop.

EDITORIAL

LITTERBUG

Sunlight focused by an empty bottle on tinder-dry grass may well have caused the two-million-dollar-plus Laurel Canyon fire in California, say fire officials.

Homes lost in the blaze number 38, and uncounted are the hopes and dreams incinerated, possibly because of a bottle carelessly tossed aside.

The same bottle focuses attention on the problem of national untidiness. The solution lies with each of us, in the way we dispose of debris.

THE SQUARE PRINCIPLE

If students understand the square principle it will help them to understand

how the kinetic energy of a moving car and the car's braking distance increase by the square of the speed of the car,
how acceleration and deceleration distanc[illegible]vered by a car increase and decrease by the square of the time, and
how centrifugal force acting on a car in a cu[illegible] increases by the square of the speed of the car.

In the illustrations below these "square" increase[illegible]e compared with the way in which the **weight** of a fluid increases by its **volume** (various speeds will be used in illustrations, some in excess of 55 mph, to show the dramatic differences in the square principle):

1. The **weight** of a fluid increases by the **volume** of the fluid. We assume ten gallons of a fluid weighs 80 lbs.

10 gallons =	20 gallons =	30 gallons =	40 gallons =
	2 x 80 lbs =	3 x 80 lbs =	4 x 80 lbs =
80 lbs	160 lbs	240 lbs	320 lbs

2. The **kinetic energy** of a car **increases** by the **square** of the car's **speed**. We assume the car weighs 3,000 lbs to obtain its energy. At 10 mph the car possesses 10,000 ft lbs of kinetic energy.

$$KE = \frac{\text{weight} \times (MPH)^2}{30} = \frac{3000 \times 10^2}{30} = 10{,}000 \text{ ft lbs}$$

KE at 10 mph =	KE at 20 mph =	KE at 30 mph =	KE at 40 mph =
	$2^2 \times 10{,}000 =$	$3^2 \times 10{,}000 =$	$4^2 \times 10{,}000 =$
	4 x 10,000 =	9 x 10,000 =	16 x 10,000 =
10,000 ft lbs	40,000 ft lbs	90,000 ft lbs	160,000 ft lbs

a. In the fluid problem we find the **number of times** the volume is increased and multiply the number by the weight of 10 gallons.

b. In the kinetic energy problem we find the number of times the speed is increased, **we square this number**, and multiply the square of the number by the energy of the car at 10 mph. If kinetic energy increased as does the weight, the energy at 40 mph would be 40,000 ft lbs instead of 160,000 ft lbs.

How 1 mph increases braking distance:

A car's braking distance increases by the square of the speed because the car's kinetic energy does. Note how the braking distance increases according to the square principle when only 1 mph is added to the speed of a car traveling 60 mph.

$$BD = \frac{(MPH)^2}{30 \times BE}$$

BD = braking distance.
BE = braking effort.
The "30" is a constant.

A braking effort of 50% decelerates a car at a rate of 16 ft/sec/sec, which is 50% of gravity (0.50 x 32 = 16). This rate is firm braking and is the top rate desirable at high speeds. At 60 mph the braking distance is 240 ft:

$$BD = \frac{60^2}{30 \times 0.50} = \frac{3600}{15} = 240 \text{ ft.}$$

At 61 mph the braking distance is 248 ft: $BD = \frac{61^2}{30 \times 0.50} = \frac{3721}{15} = 248$ ft.

Increasing the speed from 60 mph to 61 mph increases the braking distance 8 ft.

How 5 mph increases braking distance:

Calculate the braking distance at 65 mph and you will get 281.67 ft. This is 41.67 ft longer than the distance at 60 mph. This is the braking distance of 5 mph when it is added to 60 mph. Compare this 41.67 ft with the braking distance at a top speed of 5 mph:

$$BD = \frac{5^2}{30 \times 0.50} = \frac{25}{15} = 1.67 \text{ ft.}$$

The square principle makes very important what your speed is when you add 5 mph. In our comparison it makes a difference of 40 ft.

Let us see at what speed the car must travel to have a braking distance equal to the increased braking distance of 41.67 ft.

$41.67 = \frac{(MPH)^2}{30 \times 0.50} = \frac{(MPH)^2}{15}$. Making $(MPH)^2$ the subject of the equation we get $(MPH)^2 = 41.67 \times 15 = 625$

$$MPH = \sqrt{625} = 25 \text{ mph}$$

Adding 5 mph to 60 mph increases the braking distance an amount equal to the car's braking distance at 25 mph. And, of course, it adds to the car's energy an amount the car would have if traveling 25 mph.

3. The **distance** traveled by a car that is accelerating (at a constant rate) from a stop **increases** by the **square** of the **time.** We assume a car is accelerating at a rate of 4 ft/sec/sec. That is, during each second it increases its speed 4 ft/sec. During the 1st sec its speed is changed from 0 ft/sec to 4 ft/sec. Its average speed is 2 ft/sec ($\frac{0 + 4}{2} = 2$). During the 1st sec, therefore, it travels 2 ft.

In 1 sec:	In 2 sec:	In 3 sec:	In 4 sec:
$1^2 \times 2$ ft =	$2^2 \times 2$ ft =	$3^2 \times 2$ ft =	$4^2 \times 2$ ft =
1×2 ft =	4×2 ft =	9×2 ft =	16×2 ft =
2 ft	8 ft	18 ft	32 ft = total distance

We show below how distances covered each second accumulate to match the distances above and also how the rate of acceleration 4 ft/sec/sec is related to the distance covered each second:

Distance each sec:	1st sec: 2 ft	(+ 4 =)	2nd sec: 6 ft	(+ 4 =)	3rd sec: 10 ft	(+ 4 =)	4th sec: 14 ft
Accumulated distance:	0 / 2 ft		2 ft / 8 ft		8 ft / 18 ft		18 ft / 32 ft = total distance

4. The **distance** traveled by a car that is decelerating (at a constant rate) **decreases** by the **square** of the **time,** but the longest distance in any second is covered the 1st second, and the shortest distance in any second is covered the last second of deceleration. We assume a car traveling 64 ft/sec (43.65 mph) decelerates at a rate of 16 ft/sec/sec. The car will come to rest in 4 sec (64/16 = 4).

In 1 sec at 64 ft/sec the car would go 64 ft (64 x 1 = 64). However, it lost a speed of 16 ft/sec during its 1st sec of decleration. Its speed was reduced in 1 sec from 64 ft/sec to 48 ft/sec. Its average speed during the 1st sec was 56 ft/sec ($\frac{64 + 48}{2} = \frac{112}{2} = 56$). Note that the **average** speed during the 1st sec was 8 ft/sec less than the initial speed of 64 ft/sec. The distance covered during the 1st sec was 56 ft (64 - 8 = 56, and $56 \frac{\text{ft}}{\text{sec}} \times 1 \text{ sec} = 56$ ft).

In the formula below we multiply the initial speed by the time to find the distance the car would go at a constant speed. We then subtract the **average** of the rate of **deceleration** multiplied by the **(time)²** from the constant speed distance to find the distance covered during deceleration, for any given time.

$s = ut - \frac{at^2}{2}$ s = distance in ft; a = rate of deceleration in ft/sec/sec; u = initial speed in ft/sec; t = time in sec

In our problem u = 64 ft/sec and a = 16 ft/sec/sec, so

$s = 64t - \frac{16t^2}{2} = 64t - 8t^2$ = distance covered for any given number of seconds.

In 1 sec:	In 2 sec:	In 3 sec:	In 4 sec:
64 x 1 = 64	64 x 2 = 128	64 x 3 = 192	64 x 4 = 256
-8 x 1^2 = -8	-8 x 2^2 = -32	-8 x 3^2 = -72	-8 x 4^2 = -128
accumulated distance = 56 ft	= 96 ft	= 120 ft	= 128 ft = total distance

We show below how distances covered each second accumulate to match the distances above and how the rate of deceleration 16 ft/sec/sec is related to the distance covered each second:

Distance each sec:	56 ft	(-16 =)	40 ft	(-16 =)	24 ft	(-16 =)	8 ft
Accumulated distance:	0		56		96		120
	56 ft		96 ft		120 ft		128 ft = total distance

5. For a given car on a given curve the centrifugal **force** (CF) **increases** by the **square** of the **speed** in ft/sec.

$CF = \frac{\text{weight} \times v^2}{32 \times \text{radius}}$ v = ft/sec. weight = lbs. radius = ft. 32 = gravity.

We assume a car weighing 3200 lbs travels around a curve of 225 ft radius at four different speeds starting with 15 ft/sec (approx. 10 mph). Using the formula we find the CF at 15 ft/sec to be 100 lbs. $CF = \frac{3200}{32} \times \frac{15^2}{225} = 100 \times \frac{225}{225} = 100$ lbs

CF at 15 ft/sec =	CF at 30 ft/sec =	CF at 45 ft/sec =	CF at 60 ft/sec =
	$2^2 \times 100$ =	$3^2 \times 100$ =	$4^2 \times 100$ =
	4 x 100 =	9 x 100 =	16 x 100 =
100 lbs	400 lbs	900 lbs	1600 lbs

After we have the CF at a given speed, we need only to find the **number of times** the given speed is increased, **square that number,** and mulitply the square of the number by the force at the given speed. At 15 ft/sec the force is 100 lbs. At 60 ft/sec the speed is 4 times greater. $4^2 = 16$. And 16 x 100 lbs = 1600 lbs = force at 60 ft/sec. Of course, the formula will give the forces directly, but the illustration may make it easier for students to see how, due to the square principle, the force increases at a much faster rate than the speed increases.

How 1 mph increases CF:

Assume the friction value of a curve's pavement is 0.5 and that a car travels the curve at 60 ft/sec. The car weighs 3000 lbs. The pavement can hold the car on the road against a side force of 0.5 x 3000 lbs = 1500 lbs, which is the CF at 60 ft/sec. Any force in excess of 1500 lbs would make the car slide. Now note how much the force increases (due to the square principle) when the speed is increased only 1.5 ft/sec (approx. 1 mph). The speed then is 61.5 ft/sec instead of 60 ft/sec.

$CF = \frac{\text{weight} \times v^2}{32 \times 225} = \frac{3000 \times (61.5)^2}{7200} = \frac{3000 \times 3782.25}{7200} = \frac{11346750}{7200} = 1576$ lbs

Increasing the speed 1 mph adds an extra side force of 76 lbs, which is 76 lbs too much for the car to continue in the curve. The driver either must steer off the curve or the rear wheels will slide sideways and start the car into a spin.

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